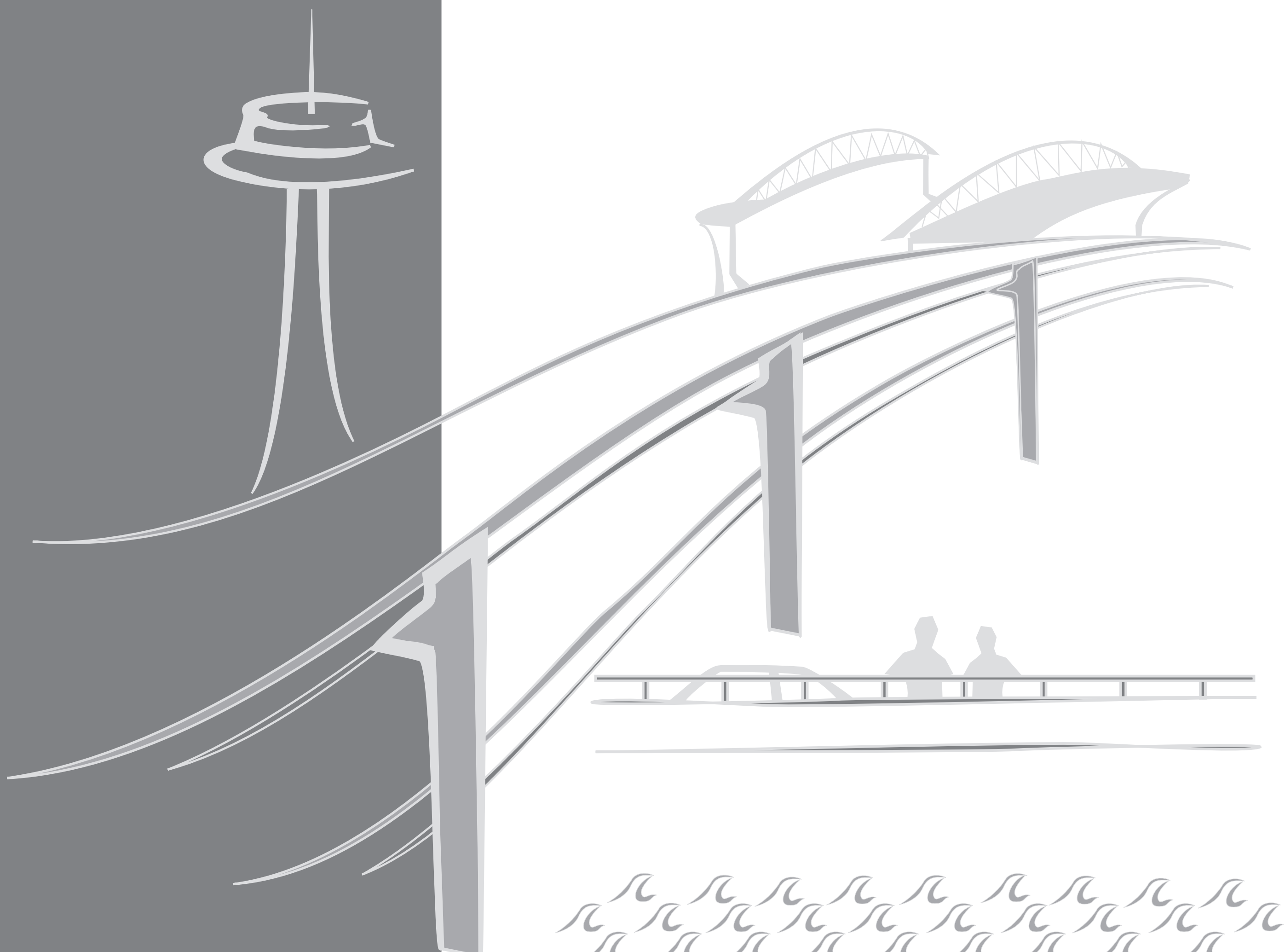
SR 99: ALASKAN WAY VIADUCT &
SEAWALL REPLACEMENT PROJECT

Draft Environmental Impact Statement

Appendix C
Transportation Discipline Report



MARCH 2004

Submitted by:
PARSONS BRINCKERHOFF QUADE & DOUGLAS, INC.

Prepared by:
PARSONS BRINCKERHOFF QUADE & DOUGLAS, INC.

U.S. Department of Transportation
Federal Highway Administration

Washington State Department of Transportation

City of Seattle

This Page Intentionally Left Blank

SR 99: Alaskan Way Viaduct & Seawall Replacement Project

Draft EIS
Transportation Discipline Report

Agreement No. Y-7888

FHWA-WA-EIS-04-01-D

Submitted to:

Washington State Department of Transportation
Alaskan Way Viaduct and Seawall Replacement Project Office
999 Third Avenue, Suite 2424
Seattle, WA 98104

The SR 99: Alaskan Way Viaduct & Seawall Replacement Project is a joint effort between the Washington State Department of Transportation (WSDOT), the City of Seattle, and the Federal Highway Administration (FHWA). To conduct this project, WSDOT contracted with:

Parsons Brinckerhoff Quade & Douglas, Inc.

999 Third Avenue, Suite 2200
Seattle, WA 98104

In association with:

BERGER/ABAM Engineers Inc.
BJT Associates
David Evans and Associates, Inc.
Entech Northwest
EnviroIssues, Inc.
Harvey Parker & Associates, Inc.
Jacobs Civil Inc.
Larson Anthropological Archaeological Services Limited
Mimi Sheridan, AICP
Parametrix
Preston, Gates, Ellis, LLP
ROMA Design Group
RoseWater Engineering, Inc.
Shannon & Wilson, Inc.
Taylor Associates, Inc.
Tom Warne and Associates, LLC
William P. Ott

This Page Intentionally Left Blank

TABLE OF CONTENTS

LIST OF EXHIBITS

ACRONYMS

AVO	average vehicle occupancy
AWV	Alaskan Way Viaduct
BINMIC	Ballard Interbay Northend Manufacturing and Industrial Center
BNSF	Burlington Northern Santa Fe Railway Company
BST	Battery Street Tunnel
CBD	Central Business District
CD	collector-distributor
EIS	environmental impact statement
FHWA	Federal Highway Administration
HAC	High Accident Corridor
HAL	High Accident Location
HCM	Highway Capacity Manual
HCT	high-capacity transit
HOV	high-occupancy vehicle
ICU	intersection capacity utilization
IDT	Interdisciplinary Team
LOS	level of service
MOE	measure of effectiveness
mph	miles per hour
NB	northbound
PAL	Pedestrian Accident Location
pcphpl	passenger car equivalents per hour per lane
pcpmpl	passenger car equivalents per mile per lane
PSRC	Puget Sound Regional Council
SB	southbound
SIG	Seattle International Gateway
SODO	South of Downtown
SOV	single-occupancy vehicle
SR	State Route
UDC	Urban Design Concept
UPRR	Union Pacific Railroad
V/C	volume to capacity ratio
WSDOT	Washington State Department of Transportation

This Page Intentionally Left Blank

Chapter 1 INTRODUCTION AND OVERVIEW

1.1 Introduction

State Route 99 (SR 99) is an important highway facility that serves both local and regional travel demands in the central Puget Sound area. SR 99 passes through downtown Seattle as the Alaskan Way Viaduct (AWV), an elevated two-level structure adjacent to the waterfront. The AWV, as well as the seawall that runs parallel and adjacent to the viaduct along the central Seattle waterfront, are both at the end of their useful life. Improvements to both are required to protect public safety and maintain this vital transportation corridor. Therefore, the Federal Highway Administration (FHWA), Washington State Department of Transportation (WSDOT), and the City of Seattle (City) have initiated the Alaskan Way Viaduct and Seawall Replacement Project.

This Transportation Discipline Report, Appendix C to the Alaskan Way Viaduct and Seawall Replacement Project Draft Environmental Impact Statement (EIS), describes transportation conditions associated with the SR 99 corridor through the downtown Seattle area and predicts transportation performance and impacts of alternatives being considered for replacing the Alaskan Way Viaduct and the Alaskan Way Seawall. These alternatives are fully evaluated in the Draft EIS for this project.

The project boundaries generally follow the SR 99 alignment from approximately S. Spokane Street on the south to Ward Street north of the Battery Street Tunnel (BST). The project includes constructing replacement structures for both the Alaskan Way Viaduct and Alaskan Way Seawall. The analysis presented in this report focuses on conditions within a transportation study area that is roughly bordered by I-5 to the east, Puget Sound to the west, Roy Street/Valley Street in the north, and S. Spokane Street in the south. It includes a range of multimodal transportation facilities and service types, including limited access highways, arterial streets, high-occupancy vehicle (HOV) facilities, transit services and facilities, ferry services and facilities, nonmotorized facilities and routes, and important freight corridors.

1.2 Overview

The Transportation Discipline Report comprises the following chapters:

Chapter 2: Methodology. Describes the methods used to predict, assess, and describe transportation system performance and impacts.

Chapter 3: Studies and Coordination. Summarizes plans, projects, and policy documents relevant to the study.

Chapter 4: Affected Environment: Describes exiting transportation conditions.

Chapter 5: Operational Impacts and Benefits. Describes the future (year 2030) performance of transportation facilities and assesses each alternative under predicted future conditions.

Chapter 6: Construction Impacts: Discusses transportation during construction stages.

1.3 Alternatives Studied

Five basic alternatives are considered in the Draft EIS and analyzed under future (year 2030) conditions in this Transportation Discipline Report. Additionally, the current configuration of SR 99 is assessed for existing conditions as well as future conditions.

1.3.1 No Build Alternative

The Alaskan Way Viaduct and Seawall Replacement Project Draft EIS considers three No Build scenarios, given the unpredictability associated with the long-term structural viability of the facility:

1. Continued operation of the viaduct and seawall with continued maintenance.
2. A moderate-level seismic event (similar to the Nisqually earthquake) causing portions of the viaduct to be taken out of service until it can be repaired or replaced.
3. A strong seismic event causing catastrophic failure of the viaduct and seawall.

The Transportation Discipline Report analyzes traffic and transportation conditions consistent with Scenario 1 to allow for comparison of the Build Alternatives to the current facility, but under 2030 traffic conditions. This scenario is referred to in this report as the 2030 Existing Facility scenario. While this scenario is useful for assessing the performance and impacts of the Build Alternatives relative to the facility that is in place today, it should be recognized that the current facility is reaching the end of its service life, and is unlikely to remain in satisfactory condition for use for the long term.

1.3.2 Rebuild Alternative

The Rebuild Alternative includes a combination of new construction, rebuild and retrofit of the Alaskan Way Viaduct, and a rebuild of the seawall. The alignment for the Rebuild Alternative generally follows the existing SR 99 alignment from S. Holgate Street to the Battery Street Tunnel.

The southbound off-ramp and northbound on-ramp to and from Western Avenue (Battery Street ramps) would be closed, while the corresponding northbound off-ramp and southbound on-ramps (Western/Elliott ramps) would be maintained. Access to downtown would be provided northbound by a Seneca Street off-ramp and southbound by a Columbia Street on-ramp. The First Avenue S. ramps (to and from the north) would be removed, and a new full interchange provided at S. Royal Brougham Way and S. Atlantic Street, west of First Avenue. North of the Battery Street Tunnel, the existing configuration would be maintained.

(Note: The transportation analysis presented in this study presumed no new connections provided at King Street under the Rebuild Alternative. Connections to downtown would only be provided by the Columbia and Seneca Street ramps, as they are today. Other analysis in support of the DEIS considered a new northbound off-ramp at King Street in addition to the Seneca Street off-ramp. The transportation related effects of including this additional off-ramp would be negligible, and limited to potential minor changes to specific intersection operations. The addition of ramps at King Street is fully examined under the Tunnel and Bypass Tunnel alternatives.)

1.3.3 Aerial Alternative

The Aerial Alternative includes construction of a new aerial structure between S. Walker Street and the existing Battery Street Tunnel, retrofitting and upgrading the Battery Street Tunnel for fire/life safety improvements north of the Battery Street Tunnel, and rebuilding the existing Seattle seawall. The Aerial Alternative provides similar connections and lane configurations as the Rebuild Alternative. North of the Battery Street Tunnel, Mercer Street would be widened between Fifth Avenue and Dexter Avenue, a second grade-separated crossing would be provided at Thomas Street, and the existing southbound off-ramp to Broad Street and northbound off-ramp to Mercer Street would be removed.

1.3.4 Tunnel Alternative

The Tunnel Alternative would replace the existing SR 99 Alaskan Way Viaduct with a new six-lane roadway (three lanes in each direction) from S. Hanford Street to Pike Street, located generally along the alignment of the existing SR 99 corridor. At Pike Street, the mainline would diverge from the seawall along the waterfront with a new four-lane (two lanes in each direction) connection to the existing Battery Street Tunnel. A northbound off-ramp and southbound on-ramp to and from the Alaskan Way surface street would replace the function of the existing Elliott/Western Avenue ramps. No ramps would be provided in the tunnel segment to downtown. Instead, access would be provided by a new northbound off-ramp and southbound on-ramp to and from Alaskan Way surface street in the vicinity of King Street. Traffic destined for downtown would use an expanded Alaskan Way to distribute traffic to the downtown streets from the new King Street ramps. At S. Royal Brougham Way and S. Atlantic Street, full access would be provided using the same configuration as the Rebuild Alternative. North of the Battery Street Tunnel, the Tunnel Alternative would have the same configuration as described for the Aerial Alternative.

1.3.5 Bypass Tunnel Alternative

The Bypass Tunnel Alternative would replace the existing SR 99 Alaskan Way Viaduct with an expanded Alaskan Way surface street coupled with a four-lane tunnel that would accommodate the SR 99 mainline through downtown. Like the other alternatives, the Bypass Tunnel Alternative would provide full access at S. Royal Brougham Way and S. Atlantic Street. As with the Tunnel Alternative, ramps to and from S. King Street would provide access to downtown. Only two lanes would be provided in each direction between the King Street ramps and the Battery Street Tunnel, as no ramps are provided at Elliott Avenue or Western Avenue. Thus, the King Street ramps and Alaskan Way surface street would also accommodate trips that formerly used the Elliott Avenue and Western Avenue ramps. North of the Battery Street Tunnel, the Bypass Tunnel Alternative would have the same configuration as described for the Aerial Alternative.

1.3.6 Surface Alternative

The Surface Alternative would replace the existing SR 99 Alaskan Way Viaduct with a surface urban arterial through downtown. An expanded Alaskan Way surface street would replace SR 99 between S. King Street and Pike Street. The surface arterial would consist of eight lanes (four lanes in each direction) south of Yesler Way and six lanes between Yesler Way and Pike Street. A new intersection near Pike Street would connect the northern segment of Alaskan Way to the SR 99 mainline. North of Pike Street, the mainline would climb to the Battery Street Tunnel, with a northbound off-ramp and southbound on-ramp provided at Western Avenue and Elliott Avenue respectively. South of downtown, the Surface Alternative would transition to a limited access design similar to the Rebuild, Tunnel, and Bypass Tunnel Alternatives. A full interchange would provide access in all directions at S. Royal Brougham Way and S. Atlantic Street. North of the Battery Street Tunnel, the Surface Alternative would have the same configuration as described for the Aerial Alternative.

1.3.7 Alternative Design Options

The alternatives have several alternative variations, which could also be implemented. The design options are described in detail in Appendix B, Alternatives Description and Construction Methods Technical Memorandum. Additional information regarding the expected performance of the design options is presented in Chapter 5 for instances where a notable difference in performance would be anticipated.

This Page Intentionally Left Blank

Chapter 2 METHODOLOGY

This chapter summarizes the overall study approach, as well as the techniques and tools used to develop transportation data, perform operational impact analysis of existing and future traffic conditions, and assess multimodal transportation system performance for the Alaskan Way Viaduct and Seawall Replacement Project.

2.1 Study Approach

This study followed a conventional corridor-level transportation planning analysis approach, involving data collection, investigation of existing traffic and transportation system conditions, and assessment of projected future conditions. The roles and performance of general-purpose traffic, transit and other high-occupancy vehicle (HOV) modes, freight, and nonmotorized traffic were evaluated.

Chapter 4, Affected Environment, summarizes existing transportation conditions for SR 99, as well as for other nearby or related transportation facilities. The assessment includes identification and description of current transportation system components, computation of existing operating conditions, and evaluation of a number of transportation-related measures of effectiveness (MOEs). These MOEs assess a variety of performance measures and are grouped by focus (highway-related, transit, freight, nonmotorized, ferry system impacts, and construction). Traffic data supporting the measure are likewise organized by focus areas. These specific elements are described in detail below.

To gauge the longer-term functionality and performance of the SR 99 corridor and other affected transportation system components, projected year 2030 roadway conditions were estimated. A 2030 Existing Facility scenario (often referred to as a No Action Alternative) was developed to represent the current SR 99 configuration under forecasted 2030 traffic conditions. This alternative serves as a future basis against which the Build Alternatives can be compared. The same performance measures evaluated for existing conditions were again assessed for the 2030 Existing Facility scenario.

Because the viaduct and seawall structures could be vulnerable in a seismic event, three No Build scenarios are evaluated in the Alaskan Way Viaduct and Seawall Replacement Project Draft EIS. These scenarios are:

- Scenario 1 – Continued operation of the viaduct and seawall with planned replacement.

- Scenario 2 – Sudden unplanned loss of the viaduct and/or seawall but without major collapse or injury.
- Scenario 3 – Catastrophic failure and collapse of the viaduct and/or seawall.

The Transportation Discipline Report analyzes traffic and transportation conditions consistent with Scenario 1 to allow for comparison of the Build Alternatives to the current facility, but under 2030 traffic conditions. This scenario is referred to in this report as the 2030 Existing Facility scenario. While this scenario is useful for assessing the performance and impacts of the Build Alternatives relative to the facility that is in place today, it should be recognized that the current facility is reaching the end of its service life, and is unlikely to remain in satisfactory condition for use for the long term. Given this, the potential effects of loss the viaduct and/or seawall, as identified for Scenarios 2 and 3 above, are also described in summary.

Each Build Alternative was also analyzed analogous to the 2030 Existing Facility to determine estimated traffic patterns and system performance under 2030 conditions. These analyses compose Chapter 5, Operational Impacts and Benefits.

2.2 Data Collection

Data collection efforts are documented in detail in the Data Documentation Report, Existing Traffic Conditions (Draft), September 15, 2002. A summary of data collection activities is presented below.

2.2.1 Current Traffic Volumes and Related Traffic Data

Mainline SR 99 Traffic Counts

Mainline and ramp volumes for SR 99 were derived from traffic counts conducted for this study in 2002, as well as supplemental counts provided by the City of Seattle. The data was analyzed for consistency, and then balanced to formulate the final traffic estimates used for PM peak hour analysis.

Intersection and Arterial Traffic Counts

Manual turning movement counts were conducted in 2002 during AM and PM peak periods (6:00 to 9:00 AM and 3:00 to 6:00 PM). Counts were conducted between Monday afternoon and Friday morning. Friday afternoons and Monday mornings were excluded since traffic volumes are reduced immediately prior to, or following, weekends. No counts were conducted on holidays or immediately prior to or following holidays. Counts were also not conducted during severe weather (serious enough to prompt school closures).

Quality control was performed on all turning movement counts by comparing volumes to adjacent intersection count volumes as well as to midblock arterial counts, where available, to help identify invalid counts. Intersections with unusual counts that could not be otherwise explained were recounted or adjusted based on adjacent intersection data.

For each intersection, the following data were collected:

- Peak period (AM and PM) turning movement volumes
- Peak period heavy vehicle volumes (for full-sized buses and heavy commercial trucks only)
- Peak period pedestrian crossing volumes
- Peak period signal timing data, including cycle lengths and phasing information
- Intersection sketches (intersection geometry)
- Field notes (anything unusual which occurs during the count, e.g., an emergency vehicle, a collision, or nearby construction)

In addition, daily traffic volumes at approximately 50 midblock locations along arterials were collected during February and March 2002.

HOV Volumes

HOV volumes were not specifically collected. However, model data was used to estimate average vehicle occupancy (AVO), which was used to determine person throughput. Note that the SR 99 corridor does not presently contain any HOV facilities within the study area.

Nonmotorized Transportation

Pedestrian volumes at intersections were collected with the arterial turning movement counts described above. Generally, bicycle traffic was counted as part of the vehicle stream. Supplemental bicycle ridership information was collected from existing sources.

Trucks

Heavy vehicle volumes were collected during the arterial turning movement counts described above. Additional information specific to use of the SR 99 corridor by heavy trucks is summarized in the project memorandum SR 99 Truck Study (Draft), February 17, 2002. Note that following the Nisqually earthquake of February 2001, weight restrictions requiring truck traffic to use only the outside lanes of the SR 99 corridor were established; these restrictions remain in place today.

Rail

Peak hour counts of rail traffic at S. Royal Brougham Way between First Avenue S. and Fourth Avenue S. were conducted in December of 2002. In addition, estimated gate closures at S. Royal Brougham Way for rail traffic in the year 2000 were provided by WSDOT.

Accidents

Accident data for the years 1999 through 2002 was provided by the City of Seattle and WSDOT.

Parking

On-street parking in the Seattle Central Business District (CBD) and along the waterfront was counted in 2001, with additional counts in 2002 and 2003. Additional parking data, collected in 2002 by the Puget Sound Regional Council (PSRC), was also obtained.

2.2.2 Transit Service

Transit information related to service coverage, frequency, and travel times for buses that use SR 99 was identified through published schedules provided by King County Metro and Sound Transit. Transit ridership data was not specifically collected, although modeled transit ridership statistics from the travel demand model can be used to compare relative levels of transit.

2.2.3 Washington State Ferries Operations

Washington State Ferries operates a major vehicle and pedestrian ferry terminal at Colman Dock (Alaskan Way surface street between Marion Street and Yesler Way). Washington State Ferries staff provided data relating to current ferry vessel capacities, ferry operating schedules, Colman Dock vehicle holding capacity, and typical loading and unloading procedures. Information relating to street-level pedestrian activity and actual traffic counts in the area was collected as described previously in this section.

2.2.4 Roadway Configuration

SR 99 alignment and geometric data necessary to conduct traffic operations assessment—including segment length, lanes (by segment), lane width, grades, and shoulder width—was taken from mapping information generated for the design portions of the study. Arterial and local roadway configurations were collected during traffic counts, which were supplemented by site visits as necessary to determine intersection configurations at study area intersections.

2.2.5 Traffic Speeds

Posted speed limits on SR 99 were collected by field observation.

Corridor travel times, which are used as a basis to calibrate simulation models, were collected during the AM and PM peak periods. Ten floating car travel time runs were conducted in each direction on SR 99 (Spokane Street to Valley Street) between the hours of 7:00 and 9:00 AM and 4:00 and 6:00 PM.

2.3 Traffic Volume Estimates and Forecasts

Existing (2002) traffic volumes for this study were compiled from the traffic data collected in Section 2.2.1. Traffic forecasts for year 2030 conditions are based on growth projected by the PSRC's EMME/2 regional travel forecasting model. Procedures for developing specific volume estimates are summarized below.

2.3.1 Selection of Analysis Period

Detailed traffic forecasts used for traffic analysis were developed for the PM peak hour (the single hour during the evening commute when maximum traffic volumes are experienced). The PM peak hour was selected to assess transportation conditions because the highest system-wide traffic volumes are experienced during this time period. Traffic conditions also peak during the morning (AM peak hour) commute, but at levels generally somewhat lower than during the evening.

One difference noted in the corridor is that during the AM peak, traffic volumes on the northbound off-ramp at Seneca Street and the southbound off-ramps to Broad Street, Denny Way, and First Avenue are higher than during the PM peak hour, since these routes are used to access jobs that are concentrated in the downtown area. During the PM peak, the other ramp locations and overall mainline volumes peak. While the PM peak analysis detailed in this report does not capture the performance of all individual corridor segments at the peak traffic levels, it does capture the performance of the entire corridor and nearby transportation facilities during the timeframe when traffic levels overall are at their peak.

2.3.2 2002 Existing Conditions PM Peak Hour and Daily Traffic Estimates

PM Peak Hour Mainline SR 99

Traffic volume data for SR 99 was collected in 2002 at mainline and ramp locations. The count volumes were adjusted to balance PM peak hour traffic volumes for all SR 99 ramp, side-street, and mainline locations within the study area. An analysis of the traffic volume data indicated that the peak traffic volumes for the SR 99 corridor and other study area facilities generally occur between 4:00 PM to 6:00 PM. The PM peak hour for analysis was selected as 4:00 PM to 5:00 PM.

PM Peak Hour Arterial Volumes

PM peak hour volumes are based on traffic counts for major intersections in the study area, using consistent morning and afternoon peak hours.

Modeled Daily Volumes

Modeled daily volume estimates are derived directly from the regional travel demand model and are used only to compare the difference in traffic distribution effects predicted for various alternatives.

2.3.3 2030 Traffic Forecasting

Traffic Forecasting Model

A regional travel demand model was used for this study to support assessment of future conditions. The Alaskan Way Viaduct (AWV) model is an enhanced version of the PSRC regional planning model, which operates in the EMME/2 software environment. The regional model reflects assumptions for regional population and employment growth as defined in PSRC's adopted regional plan, Destination 2030, the Metropolitan Transportation Plan for the Central Puget Sound Region. In January 2003, the AWV model was updated to reflect the most recent PSRC population and employment forecasts, which included additional growth in the South Lake Union area.

Documentation of model development and validation is detailed in the Travel Forecasting Model Validation Report for Base Year (1998) model validation report (February 2002).

The travel demand model was used for the following purposes:

- To estimate changes from existing conditions in regional travel demand due to population and employment growth and planned transportation system improvements.
- To identify expected demand and traffic distributions for different Build Alternatives.
- To develop peak hour vehicle volumes for use in detailed operational analyses.

2030 Transportation System Components

The future (year 2030) scenarios (2030 Existing Facility and Build Alternatives) presume a consistent set of baseline assumptions for 2030 conditions, which are reflected in the forecasting and analysis models. The 2030 baseline transportation system consists of today's highway, street, and transit system components, as well a limited number of new facilities. Only transportation improvements that are currently identified in adopted regional plans and have a funding commitment toward implementation in place are included in this future baseline. Other planned or proposed (but unfunded) facilities are not included in the 2030 baseline model.

The new transportation system components in the 2030 baseline are:

- Seattle Monorail – Green Line project definition from West Seattle to Ballard (as defined in the Seattle Popular Monorail Plan, August 2002).
- Sound Transit Phase I System (Sounder Commuter Rail, Express Bus, and Link Light Rail between Northgate and SeaTac).
- Transit improvements identified in Metro's Six-Year Transit Development Plan, as well as a presumed 1 percent growth in transit service in subsequent years. This 1 percent growth assumption is represented by improved service frequencies.
- SR 519 Phase I Improvements (S. Atlantic Street improvements; S. Royal Brougham Way continues operating at-grade).
- Broad Street Undercrossing – new grade-separated connection between Alaskan Way surface street and Elliott Avenue in the vicinity of Broad Street. Facility was presumed to provide one lane in each direction.
- I-90 HOV reconfiguration (option 8A).
- Washington State Ferries expansion of Colman Dock and remote holding area (located north of S. Royal Brougham Way and east of Alaskan Way).

Modeled Mode Share and Implications to Vehicle Forecasts

The travel forecasting models predict substantial increases in transit use by the year 2030, particularly for trips to and from downtown. The resulting 2030 transit mode shares for the downtown area reflect a much higher share of transit use, relative to automobile use, than is estimated for today. Exhibit 2-1 illustrates the modeled mode shares for trips originating and/or destined in downtown, as well as for the entire four-county region (King, Pierce, Snohomish, and Kitsap Counties). While mode shares are forecasted to increase throughout the region, transit trips remain a small fraction of all trips regionally (5 percent in 2030). In the downtown, however, the travel demand models forecast that transit mode share will increase from 23 percent to 45 percent. As a result of the modeled mode shift to transit, the net increase in vehicle trips forecasted to and from downtown was modest. In general, SR 99 ramps and local arterials in the downtown showed little or no growth in vehicle traffic, although as described below, the analysis assumed that all segments experienced at least some minimal amount of growth.

Exhibit 2-1. Modeled Mode Share (All Trip Purposes)

	Downtown Seattle		Region (King, Pierce, Snohomish, and Kitsap Counties)	
	Existing	2030	Existing	2030
Auto (SOV + HOV)	77%	55%	97%	95%
Transit	23%	45%	3%	5%

SOV = single-occupancy vehicle

The model changes in mode share are especially evident when commute trips to downtown Seattle are examined. Exhibit 2-2 illustrates the shift in trips to transit modes predicted for travel to work in downtown.

Exhibit 2-2. Modeled Mode Share (Work Trips only to Downtown)

	Existing	2030
Auto (SOV + HOV)	56%	24%
Transit	44%	76%

While increasing transit ridership share is a trend that is consistent with increasing population and employment densities, improved transit services, and more congested roadways, the model may overestimate the mode shift that could occur by 2030.

To understand how traffic estimates might differ should the modeled mode split results overestimate transit ridership, a sensitivity test was conducted. This test involved generating model data using lower parking pricing costs than are forecasted for 2030. The test resulted in a growth rate in transit ridership that was roughly half that forecasted by the AWV model, and a resulting greater reliance on auto modes. This test, detailed in the memo DRAFT Sensitivity Test – Transit Mode Share (Parsons Brinckerhoff, June 23, 2003), found that traffic levels forecasted for regional facilities, such as SR 99, were only moderately sensitive to the level of transit ridership forecasted by the AWV model. Under the lower transit ridership conditions, traffic on SR 99 was forecasted to increase 6 to 7 percent compared to that forecasted by the AWV model. Traffic on I-5 increased by only 1 percent relative to the AWV model. Local streets, however, were found to be more sensitive to mode share estimates in the downtown area and could experience higher auto volumes should mode share estimates not be achieved. Compared to the forecasts generated by the AWV model, the lower transit ridership test showed an increase in vehicle traffic of 27 to 29 percent on arterials in the downtown area.

The sensitivity tests also revealed that traffic volumes predicted on SR 99 in the study area for 2030 are nearing the upper limit of feasible volumes due to capacity constraints elsewhere on the corridor (beyond the study area), as well as capacity constraints on roadways that feed traffic to SR 99. Substantial increases in volumes on the corridor beyond those forecasted could not occur without extensive capacity expansion to facilities that connect to the corridor.

The procedures used to establish the baseline PM peak hour 2030 traffic volumes (2030 Existing Facility) for use in detailed operational analysis (such as level of service [LOS], segment speeds, travel times) do not rely directly on link-specific modeled growth, but instead involve estimation and application of growth rates that are based on the area-wide modeled results. In addition, minimum traffic growth thresholds were also established, so that in all cases, traffic was presumed to grow at least 5 percent over current volumes by 2030. This methodology results in conservative establishment of detailed traffic estimates for analysis and decreases the likelihood (and potential magnitude) that operating conditions for 2030 were overstated.

2.3.4 2030 Existing Facility Scenario PM Peak Hour Traffic Estimates

PM Peak Hour Volumes on Mainline SR 99

PM peak hour traffic forecasts for the year 2030 were developed for the SR 99 mainline, ramps, and side streets by applying growth estimates to the existing-year traffic estimates. The growth estimates were derived based on review of both PM peak period and daily EMME/2 model results for existing conditions and for the future 2030 Existing Facility scenario.

To establish traffic volumes for the SR 99 mainline, growth at the Battery Street Tunnel was first estimated. The tunnel was selected as a control point because of its central location and consistent configuration across proposed alternatives. Year 2030 and existing year AWV models were compared to determine a net difference—or growth—in the PM peak hour volumes between the two time periods. Note that the AWV model produces forecasts that cover a 3-hour peak period. These 3-hour forecasts are converted to peak-hour forecasts by applying a factor of 0.375. This difference was then added to existing corresponding peak hour traffic estimates for the Battery Street Tunnel to establish the 2030 PM peak hour volumes in the tunnel.

With the 2030 tunnel volumes established, growth at ramp locations was determined. Growth rates were established for ramp locations considering both the modeled growth forecast for the area served by the ramps, as well as the growth forecast for mainline traffic and area-wide for the portion of the network served. Base growth rates applied to 2002 volumes to establish 2030 volumes were as follows:

- South Lake Union side streets and ramps 20 percent
- Battery Street and Elliott/Western ramps 10 percent

- Columbia/Seneca ramps 5 percent
- First Avenue S. ramps 20 percent
- S. Spokane Street ramps 5 percent

Finally, 2030 mainline volumes were calculated for each segment by adding or subtracting 2030 ramp volumes as appropriate in either direction from the Battery Street Tunnel. As a final step, ramp volumes were manually adjusted to achieve consistency with modeled mainline growth entering and exiting the corridor at both ends of the study area.

2030 Peak Hour Arterial and Local Street Forecasts

Growth rates were applied to existing arterial intersection turning movement counts to establish 2030 Existing Facility peak hour volumes. These growth rates were based on an evaluation of sub-area and screenline growth forecasted by the AWV model. The 28-year rates (2002 to 2030) for the South Lake Union area ranged from 15 to 30 percent, and for downtown, Elliott/ Western, and the Stadium/Pioneer Square area ranged from 5 to 15 percent. Manual adjustment of volumes was conducted to balance volumes at arterial/ramp interface areas, as well as to account for projected 2030 auto access to ferry services at Colman Dock.

2.3.5 2030 Build Alternative Traffic Estimates

Forecasts for the 2030 Existing Facility established a basis from which traffic estimates for each of the Build Alternatives could be derived. As described below, the 2030 build forecasts were developed using the net modeled differences between each Build Alternative and the 2030 Existing Facility scenario.

Peak Hour Volumes on Mainline SR 99

The AWV model network was modified to reflect each Build Alternative and model runs (trip distribution, mode share, and network assignment) conducted for the PM peak period. The net difference in traffic forecasted between each Build Alternative and the 2030 Existing Facility were developed by comparing the AWV model output at the Battery Street Tunnel, each ramp, and at the mainline entering and exiting the study area. For new ramps, volumes were estimated by using the baseline volumes of the ramp movements that most closely corresponded to those served by the new ramps. For example, the new northbound on-ramp at S. Royal Brougham Way was compared to the existing northbound on-ramp at First Avenue S. For those ramps that did not have a corresponding existing ramp (e.g., the northbound off-ramp at S. Atlantic Street), a volume estimate was made based on the modeled volume for the ramp, as well as consideration of upstream and downstream mainline volumes.

Once established, these volume differences between alternatives were then applied to the forecasted 2030 Existing Facility volumes in a spreadsheet model. In the final step, the resulting Build Alternative volumes were manually adjusted where necessary to achieve consistent volumes that generally corresponded to the changes in traffic distribution forecasted by the AWV model throughout the corridor.

2030 Peak Hour Arterial and Local Street Forecasts

2030 peak hour arterial and local street build forecasts were developed by comparing 2030 peak period AWV model results for the 2030 Existing Facility and Build Alternatives. For each Build Alternative, the net difference between the Build Alternative and 2030 Existing Facility was applied to the 2030 Existing Facility arterial turning movement forecast. Further manual volume adjustments were made to ensure that the arterial and local street forecasts balanced with ramp volumes. Manual adjustments were also made to reflect different unique routing requirements specific to each alternative.

2.4 Traffic Analysis

2.4.1 Traffic Simulation and Analysis Models

Mainline Traffic Operations

The traffic simulation model CORSIM was used to assess traffic operating conditions on the SR 99 mainline. CORSIM is a micro-simulation model that simulates traffic operations on highway and street facilities and reports MOEs such as speeds and traffic density. The CORSIM network was limited to the SR 99 mainline, ramp facilities, and arterial intersections at ramp termini. The network was developed using existing configuration data (lanes, segment lengths, ramp location, and similar data). Free-flow speed assumptions were developed based on posted speed limits and data collected during three peak-hour travel time runs. The CORSIM model was used to generate peak hour speeds, travel times, and mainline LOS for existing conditions, as well as for the 2030 Existing Facility and Build Alternatives. These data were used to evaluate several of the MOEs described in the following section.

A different model was used to evaluate the mainline operations under the Surface Alternative. The traffic simulation model SimTraffic was used instead of CORSIM because of its suitability for modeling arterial operations and signalized intersections. SimTraffic also includes the capability of analyzing the influence of ferry traffic exiting from Colman Dock onto SR 99. Ferry traffic simulation involved modeling pulsed traffic flows to mimic a ferry's typical unloading pattern. This procedure is detailed in a technical memorandum, Simulation of Traffic Operations near Colman Dock (Parsons Brinckerhoff, January 2004).

Arterial and Local Street Traffic Operations

Traffic operations on primary and selected secondary intersections in the study area were analyzed using Synchro traffic analysis software. Synchro is a computer program designed for analysis of intersection traffic operations. Unlike CORSIM or SimTraffic, Synchro is not based on micro-simulation, but instead relies on application of standard calculations to estimate performance measures on an intersection-by-intersection basis. Synchro also allows optimization of intersection traffic signal timings.

Selected intersections include ramp termini, new or revised intersections in the Build Alternatives, and heavily congested intersections within the following areas:

- South (Stadium/Pioneer Square) – Alaskan Way and First Avenue S., Yesler Way to S. Atlantic Street
- Central (Downtown and Belltown) – Alaskan Way to Second Avenue S., Yesler Way to Virginia Street; Elliott/Western Avenues
- North Waterfront – Alaskan Way, Elliott/Western Avenues
- North (South Lake Union) – Fifth Avenue to Dexter Avenue, Roy Street to Denny Way

2.5 Measures of Effectiveness

A number of MOEs were evaluated for existing conditions, 2030 Existing Facility conditions, and under each of the Build Alternatives. These MOEs characterize the relative differences in performance between each of the alternatives and establish traffic impacts that could be expected. They were developed with the participation of the Transportation Interdisciplinary Team (see Section 3.2.1) and with consideration of data availability and suitability. The MOEs address each of the important modes of travel operating in the corridor, both today and in the future. These include:

- Highway/roadway
- Transit/HOV
- Nonmotorized (pedestrian and bicycle)
- Freight (commercial vehicles)

MOEs were also identified to evaluate how each alternative influences safety, affects parking, and may affect travel during construction.

2.5.1 Highway MOEs

MOE H1: SR 99 Connections

This MOE consists of providing qualitative ratings for arterial connections to/from locations where some degree of access is currently provided by SR 99:

- To/from Stadium area
- To/from Elliott and Western corridor
- To/from downtown Seattle
- To/from Mercer corridor

Connections at the south end of the corridor to the Spokane Street Viaduct/West Seattle Bridge are not evaluated because no changes to the existing connections are proposed.

Connections provided for each alternative were identified by movement (e.g., northbound SR 99 to downtown Seattle) and evaluated qualitatively to determine the quality of connection provided. Connections were then graded “good,” “fair,” “poor,” or “none” (nonexistent). For each access location listed above, an overall rating was assigned to represent the range and quality of connectivity provided. The ratings represent the range of connectivity that is provided for each area, with a filled-in circle – ● – representing excellent connectivity (i.e., direct, efficient access provided to/from all directions of SR 99), while an empty circle – ○ – represents no or very poor connectivity. Successively more shaded circles – ◔, ◑, ◕ – represent increasingly higher level and quality of connectivity between the SR 99 corridor and the local street system.

The ratings reflect the range of connections provided (full access, partial access, or no access); the quality of connections (high speed/capacity ramp connections, low speed/capacity ramp connections, or arterial connections), and the type of connection provided (direct connection, short indirect connection, or longer indirect connection requiring extended arterial travel).

Results for MOE H1 are presented in Section 5.3.1.

MOE H2: Corridor Peak Hour Travel Times

This MOE summarizes 2030 AM and PM peak hour travel times for primary travel routes served by SR 99. These routes were selected to represent the range of trips that use the SR 99 corridor. The travel routes studied are described below and presented in Exhibits 2-3 through 2-6.

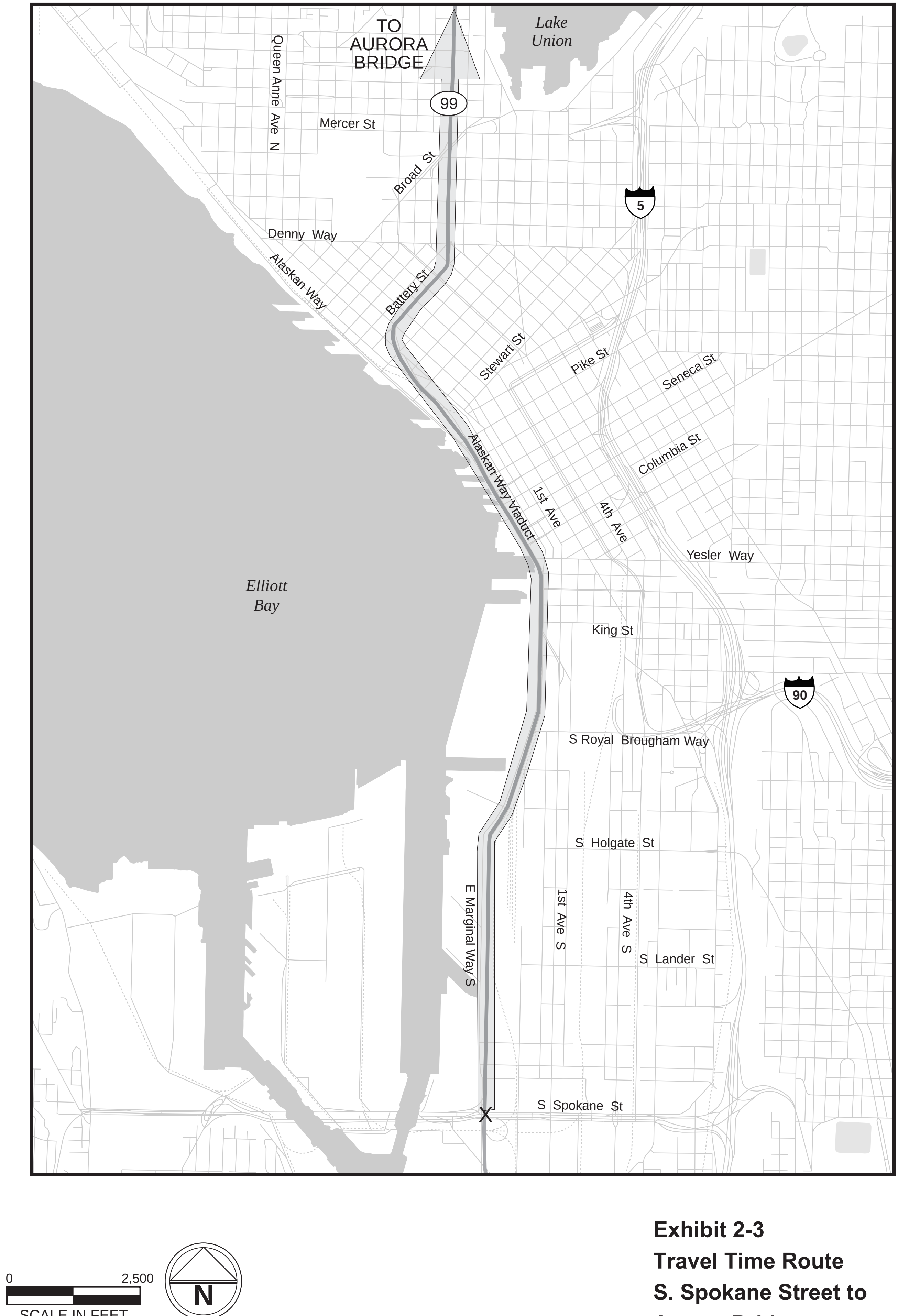


Exhibit 2-3
Travel Time Route
S. Spokane Street to
Aurora Bridge

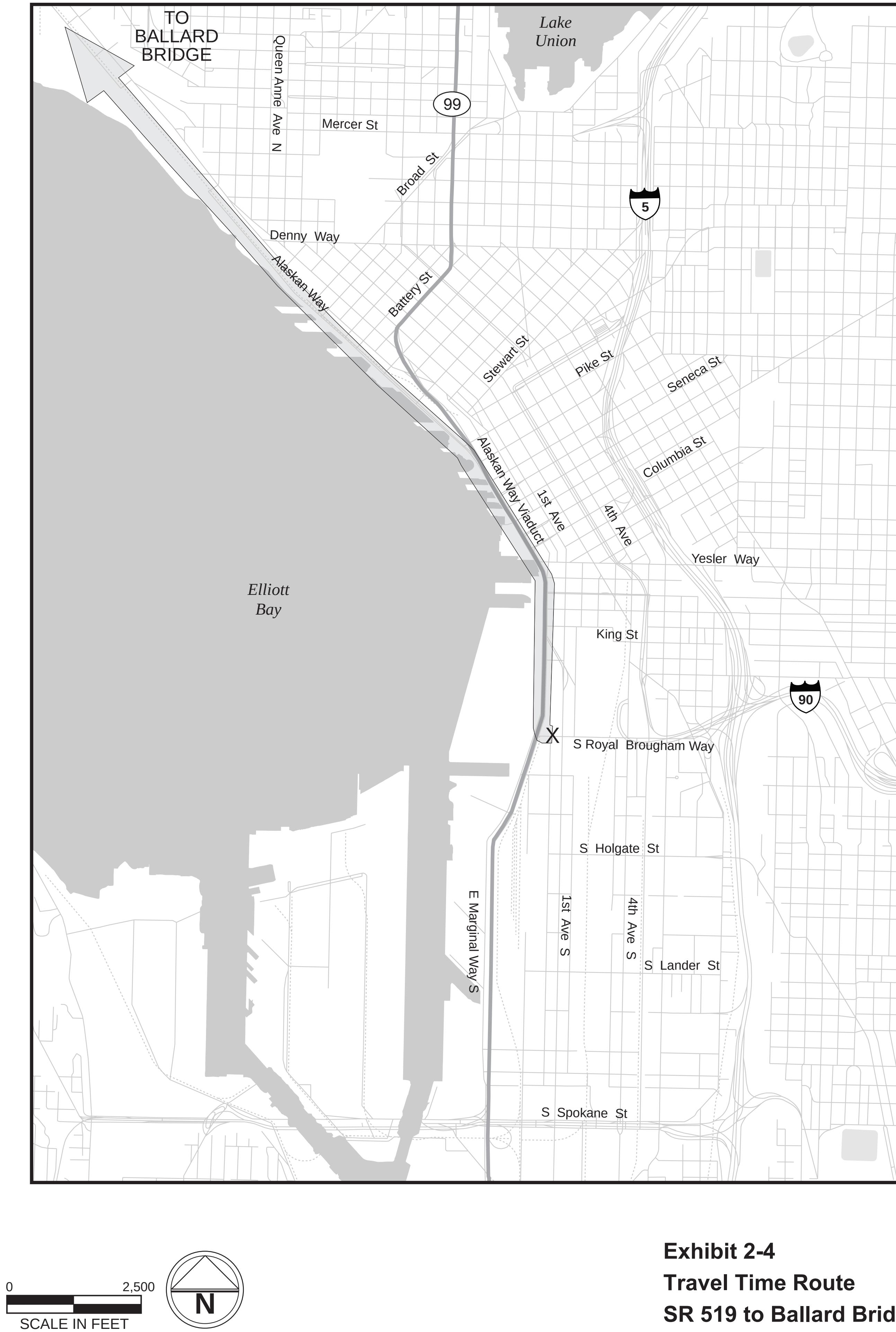
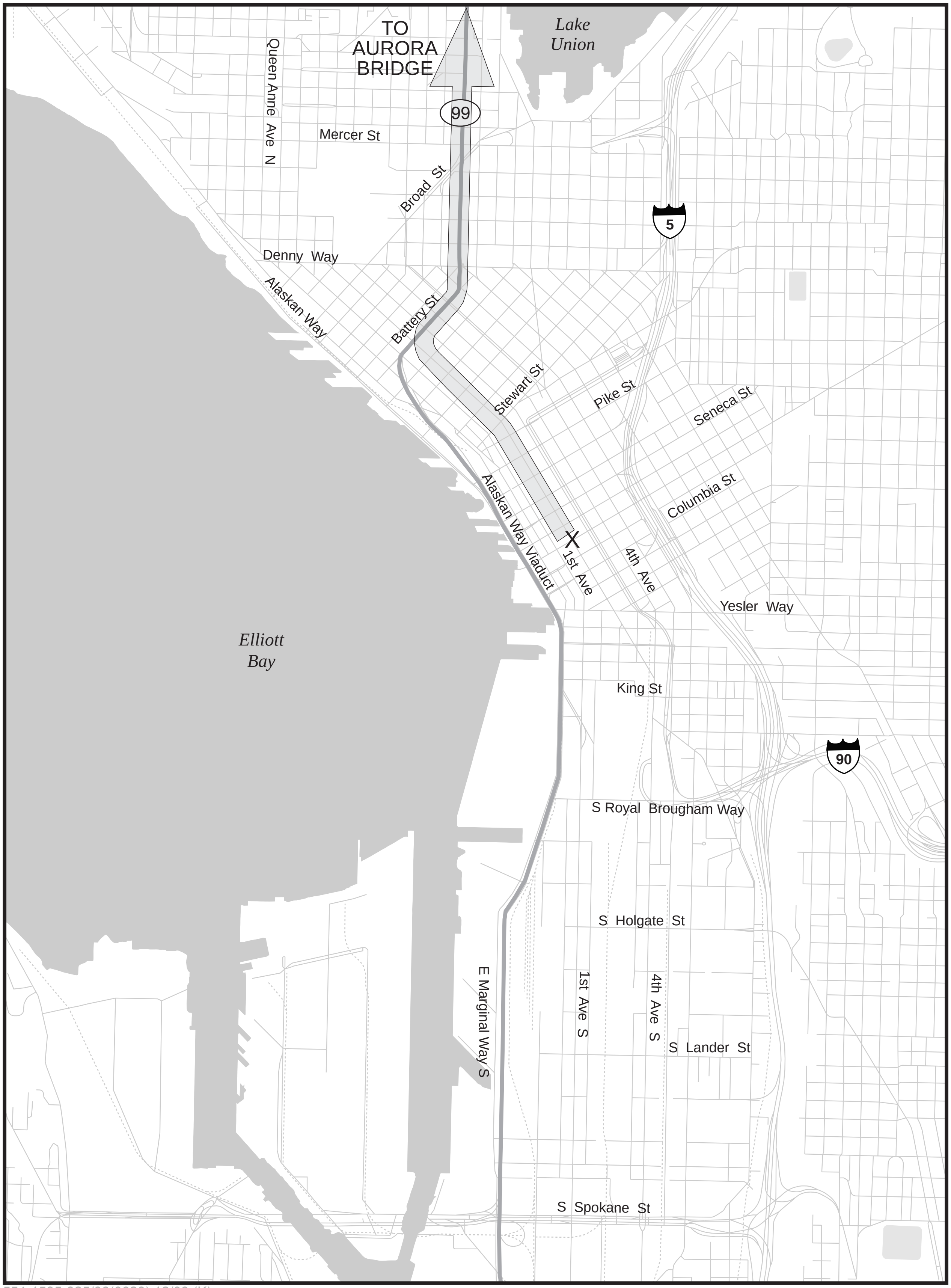


Exhibit 2-4
Travel Time Route
SR 519 to Ballard Bridge



554-1585-025/06(0620) 12/03 (K)

0 2,500
SCALE IN FEET

N

Exhibit 2-5
Travel Time Route
Downtown Seattle to
Aurora Bridge

554-1585-025/06(0620) 12/03 (K)

Exhibit 2-6
Travel Time Route
S. Spokane Street to
Downtown Seattle

- Between S. Spokane Street and the Aurora Bridge
  This route extends from just north of S. Spokane Street to just south of the Aurora Bridge on the north side of Queen Anne hill. The route is entirely on SR 99.

- Between SR 519 and Ballard Bridge
  This route extends from the First Avenue ramps (or proposed S. Royal Brougham Way ramps) to just south of the Ballard Bridge on 15th Avenue W. The route is on SR 99 through downtown, but then depending on the alternative, utilizes Elliott/Western Avenues or Alaskan Way through Belltown, and 15th Avenue W. through Interbay.

- Between downtown Seattle and the Aurora Bridge
  This route extends from the center of downtown Seattle (within a one-block radius of Second Avenue and Madison Street) to just south of the Aurora Bridge on the north side of Queen Anne hill. The route does not utilize SR 99 through downtown, as access to/from the north is not provided from downtown. Instead, the route follows First Avenue and Battery Street (northbound) and Wall Street and Second Avenue (southbound) through downtown. Access to SR 99 is at the Denny ramps, and the route follows SR 99 north of there.

- Between S. Spokane Street and downtown Seattle
  This route extends from just north of S. Spokane Street to the center of downtown Seattle (within a one-block radius of Second Avenue and Madison Street). The route follows SR 99 to the downtown access ramps (Seneca Street or S. King Street ramps northbound, Columbia or S. King Street ramps southbound) and uses the quickest arterial route downtown to reach the origin/destination location at Second Avenue and Madison Street.

These routes are intended to represent primary travel movements served by the corridor. Travel time estimates are based on a compilation of data from several sources. Within the study area, travel time estimates for all mainline segments were derived from CORSIM and SimTraffic (for the Surface Alternative) simulation results. For arterial segments (other than the surface mainline), travel time estimates were calculated based on free-flow speeds and intersection delay estimated from Synchro operational analysis results. Finally, EMME/2 link travel speeds were used as a basis for calculating travel times along route segments outside of the study area (SR 99 north of Aloha Street, and 15th Avenue W. north of Elliott Avenue), or for those for which Synchro intersection delay was not available.

Results for MOE H2 are presented in Section 5.3.2.

MOE H3: SR 99 Corridor Vehicle Throughput

Vehicle throughput measures the number of vehicles traversing the corridor at specific locations. PM peak hour vehicle throughput was calculated for five segments on the SR 99 corridor. This measure is useful in identifying capacity constraints (limitations on the number of vehicles traversing a fixed location).

Because each alternative represents a different roadway configuration with different points of access, vehicle throughput is measured at locations along the corridor where the same movements are being served by the SR 99 corridor. The matrix in Exhibit 2-7 describes the five segments studied and the corresponding location on the corridor under each alternative.

Exhibit 2-7. Vehicle Throughput Measurement Locations

	2030 Existing Facility	Rebuild	Aerial	Tunnel	Bypass Tunnel	Surface
North Corridor	North of Mercer	North of Mercer	North of Mercer	North of Mercer	North of Mercer	North of Mercer
Battery Street Tunnel	Battery Street Tunnel	Battery Street Tunnel	Battery Street Tunnel	Battery Street Tunnel	Battery Street Tunnel	Battery Street Tunnel
North Downtown	Between Elliott/ Western Ramps and Seneca Ramps	Between Elliott/ Western Ramps and Seneca Ramps	Between Elliott/ Western Ramps and Seneca Ramps	Between Alaskan Way Ramps and King Street Ramps	Between Battery Street Tunnel and King Street Ramps	Alaskan Way south of Pike Street
South Downtown	Between First Avenue and Columbia Ramps	Between First Avenue and Columbia Ramps	Between First Avenue and Columbia Ramps	South of King Street Ramps (plus SR 519 ramps to/from the North)	South of King Street Ramps (plus SR 519 ramps to/from the North)	Alaskan Way south of Yesler Way
South Corridor	North of Spokane Street	North of Spokane Street	North of Spokane Street	North of Spokane Street	North of Spokane Street	North of Spokane Street

Results for MOE H3 are presented in Section 5.3.3.

MOE H4: SR 99 Corridor Person Throughput

Person throughput measures the number of people, rather than vehicles, traveling on the corridor at specific locations during each peak hour. This measure is sensitive not only to capacity constraints and distribution of traffic, but also to changes in mode share or vehicle occupancy. This MOE measured modeled 2030 AM and PM peak hour person throughput on SR 99 at the same locations as analyzed for vehicle throughput.

Person throughput was calculated by applying an AVO to the vehicle throughput calculated in MOE H3 to calculate person-trips in auto modes, and then adding transit person trips forecasted at the selected locations by the AWV EMME/2 model to arrive at total person throughput. Review of HOV and single-occupancy vehicle (SOV) model forecasts did not show any considerable variation in the mix of carpool and non-carpool trips between alternatives. Based on regional data, a standard AVO of 1.33 was used to calculate the auto component of person throughput.

Results for MOE H4 are presented in Section 5.3.4.

MOE H5: Corridor PM Peak Hour Volume/Capacity

Volume to capacity (V/C) ratios measure the ability of the corridor to efficiently carry the traffic that uses the corridor. V/C is based on the existing or forecasted peak hour volumes and estimated capacity, by segment. In this report, the V/C is converted to a percentage to reflect the degree to which corridor segments have sufficient capacity to accommodate the forecasted vehicle demand. For example, a segment with a forecasted volume of 4,800 vehicles and an estimated capacity of 6,000 vehicles would have a V/C of 4,800/6,000 = 0.80, or 80 percent. A V/C of 100 percent or greater indicates a highway segment with insufficient capacity to accommodate the traffic forecasted for that segment. Note that traffic flow and speeds usually begin to degrade at V/C levels less than 100 percent (i.e., performance may start to degrade before capacity is reached).

Capacity estimates are based on guidance and examples in the Highway Capacity Manual (HCM) 2000. Exhibits 8-17 through 8-23 and 23-5 from HCM 2000 guided freeway segment capacity estimates, and Exhibit 21-3 (multilane highways) guided capacity estimates for SR 99 north of the Battery Street Tunnel. Synchro intersection analysis output was used to establish the capacity assumptions for the Surface Alternative.

Assumptions for corridor segment capacities are:

- SR 99 north of Battery Street Tunnel – 1,900 passenger car equivalents per hour per lane (pcphpl)
- Battery Street Tunnel – 1,900 pcphpl
- Existing viaduct segments – 2,100 pcphpl
- Replacement viaduct segments (Rebuild) – 2,200 pcphpl
- New AWV controlled access segments (Aerial, Tunnel, Bypass Tunnel) – 2,300 pcphpl

- Surface mainline segments – 800 pcphpl
- SR 99 south of SR 519 – 2,300 pcphpl

Results for MOE H5 are presented in Section 5.3.5.

MOE H6: Corridor Hours of Congested Conditions

The number of hours that the mainline is forecasted to operate under congested conditions is forecasted by estimating periods when the most congested segment V/C is expected to exceed 90 percent. The hourly distribution of traffic volumes was estimated for the most congested segment of each alternative by distributing the modeled AM, PM, and midday volume forecasts to the existing hourly count profile for SR 99 in downtown.

MOE H7: SR 99 Mainline Levels of Service and Speeds

LOS is a measure that characterizes the operating conditions, as perceived by a driver or facility user, of a highway, street, or other transportation facility. Although LOS is a qualitative measure, it is based on quantitative measures, such as vehicle density, average speed, or average vehicle delay. A range of six LOS designations, ranging from "A" to "F," are defined in the Transportation Research Board's 2000 HCM. LOS A represents ideal, uncongested operating conditions, while LOS F designates extremely congested, breakdown conditions. LOS B through LOS D designate intermediate operating conditions, while LOS E denotes congested conditions at the point of maximum service rate.

For mainline freeway segments or limited access facilities, LOS designations are based on the calculated density (in passenger car equivalents per mile per lane – pcpmpl). The 2000 HCM designated LOS ranges for freeway (limited access) segments are shown in Exhibit 2-8.

Exhibit 2-8. Level of Service Designations, Freeway Segments

LOS (Freeway Segment)	Density Range (pcpmpl)
A	0-11
B	>11-18
C	>18-26
D	>26-35
E	>35-45
F	>45

Source: 2000 HCM, Section 23-3.

These standards were used for gauging the LOS of SR 99 mainline segments between S. Spokane Street and the Battery Street Tunnel for all alternatives except the Surface Alternative.

For SR 99 segments north of the Battery Street Tunnel, a different LOS index was employed. This part of the corridor is not an exact match for any of the defined 2000 HCM categories, since it exhibits qualities of both the Multilane Highway category and the Urban Streets category. The posted speed limit for this segment of SR 99 is 40 miles per hour (mph), which is lower than typical for multilane highways. This section also experiences friction from side street access on the outside lanes. For these reasons, the 2000 HCM Urban Streets methodology was employed. While this approach results in better LOS designations for similar traffic characteristics than does the Multilane Highway approach, it does allow for better differentiation between the alternatives. Had the multilane highway approach been employed instead, LOS F designations would have been reported across all alternatives, since the multilane highway approach presumes better free-flow conditions than are provided by this segment of SR 99.

An Urban Street classification of II was selected for analyzing the northernmost section of SR 99. The type II classification represents a principal arterial in an intermediate density or suburban setting, with typical speed limits of 30 to 45 mph. The Urban Street designation does presume some signalized intersections are present, which is not the case for this segment of AWV. The LOS designations for a type II Urban Street are shown in Exhibit 2-9.

Exhibit 2-9. Level of Service Designations, Urban Street Type II

LOS (Urban Street type II)	Average Vehicle Speed
A	>35
B	>28-35
C	>22-28
D	>17-22
E	>13-17
F	<=13

Source: 2000 HCM, Exhibit 15-2.

Under the Surface Alternative, the central portion of SR 99 would be replaced by an Urban Street segment as well. The portion of SR 99 from S. King Street to Pike Street was analyzed as a type III Urban Street. This designation reflects an urban setting, with 23- to 35-mph typical speed limits, pedestrian activity, and closely spaced signalized intersections. The LOS designations for a type III Urban Street are shown in Exhibit 2-10.

Exhibit 2-10. Level of Service Designations, Urban Street Type III

LOS (Urban Street Type III)	Average Vehicle Speed
A	>30
B	>24-30
C	>18-24
D	>14-18
E	>10-14
F	<=10

Source: 2000 HCM, Exhibit 15-2.

LOS is not a good measure for directly comparing the performance of the central segment of the Surface Alternative to the 2030 Existing Facility or other Build Alternatives, since LOS is measured relative to specific facility types. For this central segment, the facility type for the Surface Alternative (signalized urban street) is different from the facility type for the other alternatives (limited access highway), so comparing the Surface Alternative's LOS to the others is not useful. Instead, the LOS presented for this central segment should be viewed as a measure of how this portion of the facility is forecasted to operate relative to other similar urban street facilities. To better help gauge performance across facility types, peak hour travel speeds are also presented for the segments analyzed for LOS.

Results for MOE H7 are presented in Section 5.3.6.

MOE H8: Traffic Distribution

Daily traffic volumes were assessed to gauge the general impacts to parallel streets and highways. Daily traffic volume forecasts from the AWV EMME/2 model were measured at three screenline locations (Exhibit 2-11): a north screenline located near Roy Street, a central screenline near Marion Street, and a south screenline north of S. Spokane Street. Overall changes in traffic volumes on I-5 and parallel (north–south) arterials under the alternatives were identified. The arterials assessed include all north–south streets between Elliott Bay and I-5.

This MOE indicates the impact on other facilities—both city streets and I-5—from each of the Build Alternatives.

Results for MOE H8 are presented in Section 5.3.7.

MOE H9: Arterial Intersection Performance

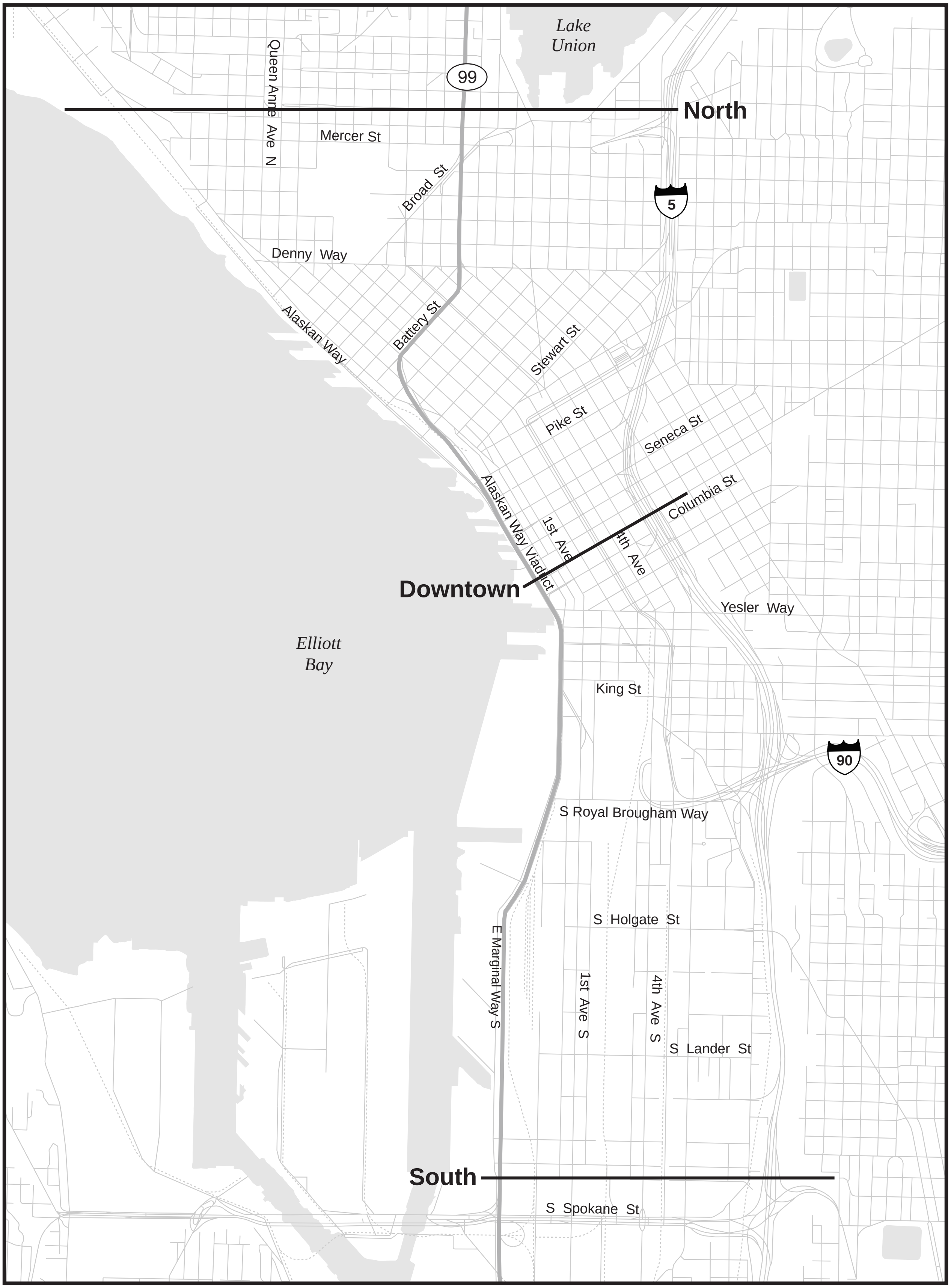
PM peak hour traffic operations were assessed using Trafficware Corporation's Synchro traffic analysis software. Intersection level of service (LOS), average vehicle delay, and intersection capacity utilization (ICU; a measure analogous to V/C ratio) are reported for selected key intersections within the study area (shown in Exhibit 2-12).

LOS is reported based on the Synchro Percentile Delay methodology. This methodology differs slightly from 2000 HCM methods, but reports LOS using the same average vehicle delay basis. The percentile delay methodology was selected because it better models actuated signal timings, coordinated signal timings, and highly congested conditions. Additionally, while Synchro (Version 5) can produce LOS results based on the 2000 HCM methodology, the results do not account for right-turn-on-red maneuvers, which can understate LOS (report poorer than actual LOS). The percentile-delay-based LOS results presented in this study do not have this limitation. Note that the analysis method used does not account for operational impacts due to queue backups from adjacent intersections, which can lead to overstating LOS (i.e., reporting better than actual LOS) in areas of closely spaced intersections under congested conditions.

ICU may be a better indicator of intersection performance across alternatives, as it is independent of signal timing assumptions (which are uncertain for analysis under future conditions). Instead, it is a measure of basic capacity compared with the traffic forecasted to use the intersection. Additionally, both delay-based and capacity-based measures of performance are evaluated since each measure can identify operational problems that the other cannot.

Intersection analysis results were used to identify locations on surface streets in the study area where traffic operations are expected to be poor during the PM peak. These intersections are identified as “congested,” and further subdivided into two categories, “moderately congested” and “highly congested.” Intersections are identified as highly congested if the PM peak hour average vehicle delay exceeds 110 seconds and the ICU is greater than 110 percent. Moderately congested intersections are those that fall below the threshold for highly congested, but have an average vehicle delay of greater than 80 seconds (i.e., LOS F) or an ICU greater than 100 percent.

The selection of intersections to evaluate was based on several factors, including proximity to SR 99, location relative to existing or proposed SR 99 ramps, and existing traffic volumes and performance. These intersections represent those that are potentially most affected by SR 99 traffic under the existing configuration or under the alternative configurations evaluated.



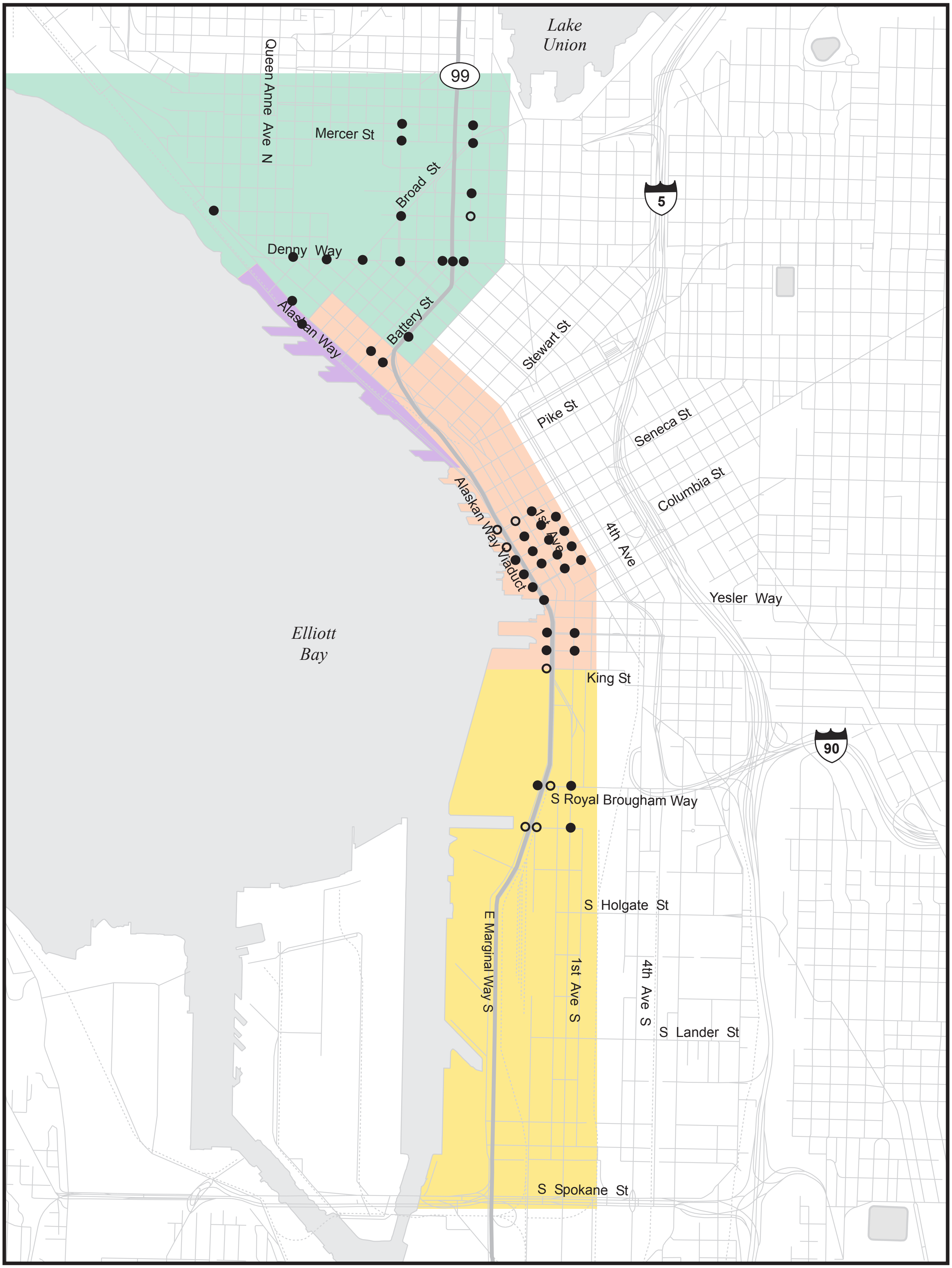
MC: 554-1585-025/06(0620) 12/03 (K)

0 2,500
SCALE IN FEET

N

Exhibit 2-11
Traffic Distribution Screenlines

This Page Intentionally Left Blank



MC: 554-1585-025/06(0620) 2/04 (K)

Signalized Intersection
Unsignalized Intersection
North
North Waterfront
Central
South

0 2,500
SCALE IN FEET

N

Exhibit 2-12
Intersections Studied

This Page Intentionally Left Blank

The LOS results are organized by the following sub-areas:

- South – Intersections in the Pioneer Square and Stadium areas on First Avenue and Alaskan Way south of Yesler Way.
- Central – Intersections in downtown Seattle on Alaskan Way, Western Avenue, First Avenue, and Second Avenue between Spring Street and Yesler Way. Intersections on Elliott Avenue and Western Avenue in the Belltown area.
- North Waterfront – Intersections on Alaskan Way, Elliott Avenue, and Western Avenue south of Denny Way.
- North – Intersections on and north of Denny Way between Broad Street and Fifth Avenue to the west and Dexter Avenue to the east.

Results for MOE H9 are presented in Section 5.3.8.

2.5.2 Transit MOEs

Three MOEs evaluate performance of the transit system in terms of connectivity, travel time, and impacts to possible high-capacity transit (HCT) implementation in the study corridor.

MOE T1: Transit Connections

This MOE assesses the SR 99 corridor's ability to provide for transit access between the SR 99 corridor and local areas within the study area. Current transit services on the SR 99 corridor enter and exit the facility to access downtown and do not travel through the central corridor or Battery Street Tunnel. Therefore, transit connection assessment focuses on how the connections to and from downtown (currently provided at Seneca and Columbia Street ramps to the south, and the Denny Way ramps to the north) are maintained or provided in alternate ways.

Results for MOE T1 are presented in Section 5.4.1.

MOE T2: Transit Travel Times and Coverage Area

The effect of each alternative on transit travel times was evaluated by comparing the routing presumed in the study area (as identified in MOE T1) and identifying potential changes to travel times for each route. Because a number of factors and assumptions not related to the SR 99 facility are involved in estimating actual transit travel times, this MOE is assessed by qualitative terms. The evaluation does consider the operational analysis performed for streets and highways in assessing how transit travel times in the study area would be affected. This MOE focuses on transit routes that use the AWV Corridor; however, generalized impacts to all surface transit routes in downtown Seattle are discussed.

Results for MOE T2 are presented in Section 5.4.2.

MOE T3: Impact to Development of Future High-Capacity Transit and High-Occupancy Vehicle Use Through the Corridor

This MOE qualitatively discusses the potential physical conflicts with proposed HCT alignments; the potential for future HOV or HCT use along the corridor under the proposed alternative; and the ability of an alternative to facilitate enhanced bus transit service, such as by providing transit priority or other measures benefiting transit services.

Results for MOE T3 are presented in Section 5.4.3.

2.5.3 Freight MOE

MOE FT1: Freight Mobility and Operations

The freight MOE evaluates several measures to assess the effect on freight and goods movement.

- Qualitative assessment of the ability of the design to provide or improve upon existing truck connections. This includes access to port facilities, Harbor Island, and the Ballard/Interbay area. It also includes the ability to cross the corridor at SR 519 to reach I-90 and I-5.
- Assessment of travel time impacts (MOE H2) on major corridor truck/freight routes.
- Qualitative assessment of ability of design to facilitate truck operations (i.e., provision of appropriate turning radii, grades, etc.).
- Qualitative assessment of effect of alternative on freight train operations or facilities.

Results for MOE FT1 are presented in Section 5.5.

2.5.4 Ferry MOE

MOE FY1: Access to/from Colman Dock

The impacts to vehicle and pedestrian access and egress from Colman Dock are assessed qualitatively, with reference to appropriate quantitative traffic operational analysis data:

- Qualitative assessment—with reference to relevant traffic measures—to gauge the ability of the local transportation system to accommodate vehicles entering and exiting Colman Dock.
- Qualitative assessment of the ability to move ferry traffic from the remote holding area to Colman Dock without disrupting other traffic. This assessment is based on operations analysis data presented with other MOEs.

- Qualitative assessment of barriers to pedestrian access of Colman Dock from the CBD.
- Qualitative assessment of the ability to serve Colman Dock by transit and taxicab.

Results for MOE FY1 are presented in Section 5.6.

2.5.5 Nonmotorized Transportation MOE

MOE N1: Effect on Nonmotorized Routes and Mobility

The impacts to pedestrian and nonmotorized modes are assessed qualitatively in four ways:

- Accessibility to, and quality of, pedestrian and bicycle facilities along Alaskan Way.
- Ability for pedestrians to reach the waterfront from the CBD.
- Potential impacts of ramp locations on pedestrians.
- Effect of changes in traffic volumes and distribution on pedestrians and bicycles.

Results for MOE N1 are presented in Section 5.7.

2.5.6 Parking MOE

MOE P1: Impact to Parking

Impacts to parking in the study area are assessed by describing the potential impact to the number and type of parking spaces provided under each Build Alternative. In addition, the location and proximity to dependent uses is qualitatively discussed. Parking was assessed for the area that would be directly affected by construction of each of the alternatives studied, as shown in Exhibit 2-13.

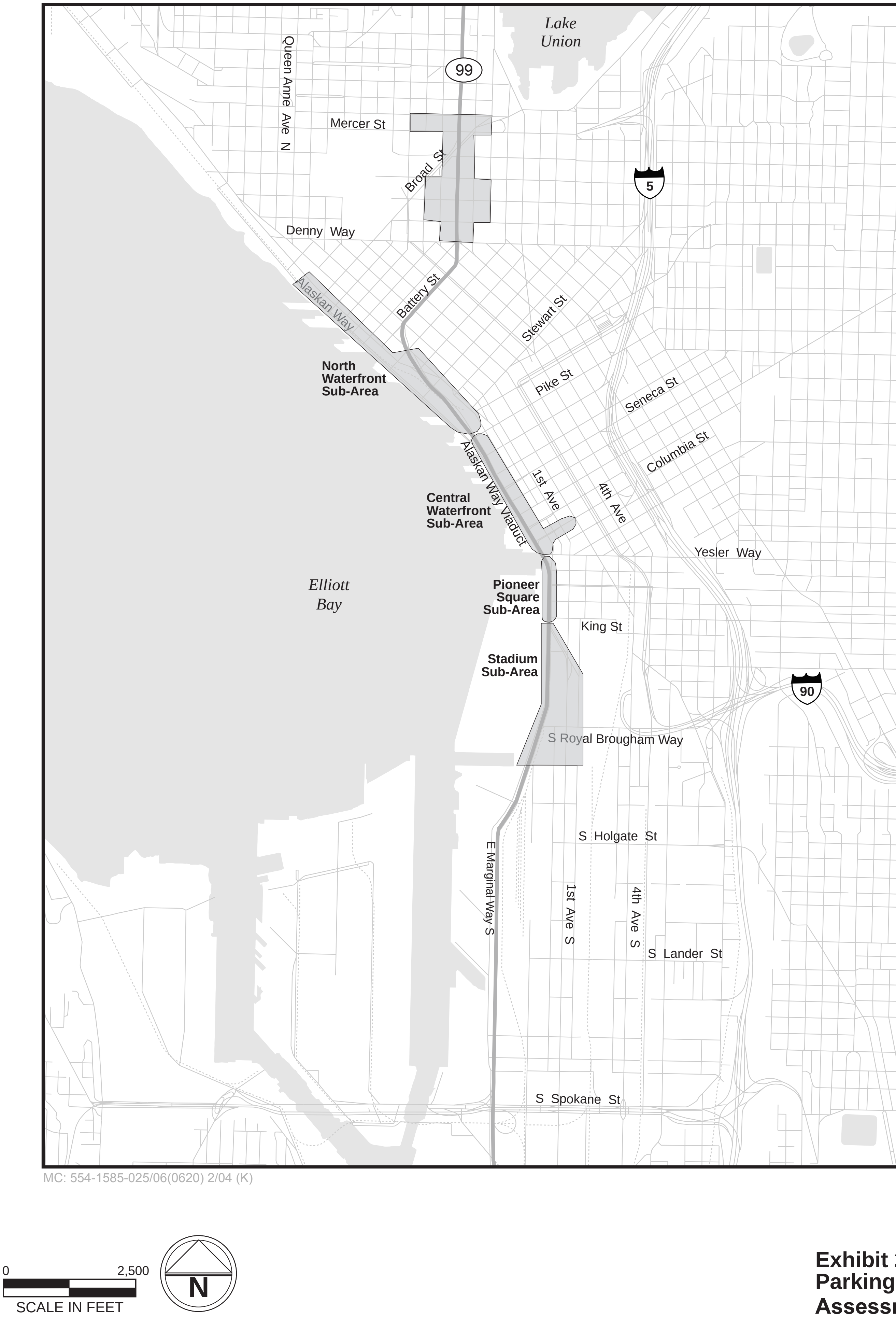
Results for MOE P1 are presented in Section 5.8.

2.5.7 Accidents and Safety MOE

MOE A1: Facility Design Features

Identification of major design elements, including facility type, lane widths, geometric configuration, and potential vehicle and pedestrian conflict locations. Assess how design features might affect existing high accident locations or potentially introduce new or different safety issues.

Results for MOE A1 are presented in Section 5.9.



MC: 554-1585-025/06(0620) 2/04 (K)

Exhibit 2-13
Parking Assessment Area

2.5.8 Construction Assessment MOEs

The estimated relative severity of traffic impacts during construction, and the ability of each alternative to accommodate traffic during construction, was assessed by using the following three MOEs:

- Projected capacity loss during representative stages of construction.
- Ability to provide adequate detour plan and maintain traffic flow during construction.
- Potential to reduce vehicle travel demand during construction.

MOE C1: Projected Capacity Loss During Representative Construction Stages

Two factors were considered in assessing the traffic impacts caused by construction: (1) severity of disruption to corridor traffic, and (2) duration of construction.

In evaluating the overall traffic impacts caused by each alternative, construction activities were grouped into representative major construction stages. Loss of traffic carrying capacity throughout the construction period was summarized by estimating the loss in corridor capacity during each construction stage, based on the preliminary construction staging plans that have been developed to date. To estimate capacity of a construction stage over time, the estimated capacity loss was multiplied by the number of months required to complete the construction stage.

For purposes of comparing corridor capacity, the project corridor includes the SR 99 mainline, detour routes that replace or supplement mainline capacity, and the Alaskan Way surface street. The following three screenline locations are evaluated:

- Just south of the First Avenue S. northbound on-ramp and southbound off-ramp.
- Just north of the Seneca Street off-ramp for northbound traffic and the Columbia Street on-ramp for southbound traffic.
- Just north of the Western Avenue off-ramp for northbound traffic and the Elliott Avenue on-ramp for southbound traffic.

The location of the screenlines may vary slightly depending on the configuration of facilities for a given construction stage.

To estimate the capacity of facilities of varying types and under differing conditions, the following general equivalency factors were applied:

- 1 freeway lane = 2 arterial lanes
- 1 ramp lane = 1 arterial lane
- 1 arterial lane in construction zone = 0.8 arterial lane

- 1 freeway lane in construction zone = 1.6 arterial lanes
- 1 lane on temporary viaduct = 1.8 arterial lanes

MOE C2: Detour Plans and Construction Stages

A qualitative assessment was made regarding the ability of each alternative to provide traffic detours during representative construction stages. The assessment addresses:

- Traffic provisions for through traffic.
- Ramp closures and the availability of replacements.
- Availability of parallel diversion routes.
- Potential traffic management measures for mitigating traffic impacts in the affected areas.

MOE C3: Potential Travel Demand Reductions

This MOE includes a qualitative assessment of each alternative's potential to reduce vehicle travel demand during construction stages through increased transit or rideshare use or by shifting trips to off-peak times. The assessment addresses the impact of the programs that have been identified as part of the Flexible Transportation Package process earlier in the Build Alternatives development process. Explicit strategies that generally constitute traditional and non-traditional demand and system management strategies were identified for each Build Alternative. The emphasis of these programs was to reduce traffic demand on local streets during the construction stage of project development, although some strategies were to continue well beyond year of opening and at least until 2030.

More information on these Flexible Transportation Strategies can be found in the report, Draft Flexible Transportation Package: An Integrated Program of Demand and System Management Strategies, December 2002.

Chapter 3 STUDIES AND COORDINATION

This section provides a summary of the studies and adopted plans undertaken in the region that have relevance to this project. Also included is a summary of coordination activities undertaken to provide guidance to the development of traffic and transportation components of the project as well as mechanisms for the evaluation of transportation system performance in support of the project EIS.

3.1 Relevant Studies and Plans

3.1.1 City of Seattle Comprehensive Plan

The City of Seattle's Comprehensive Plan, Toward a Sustainable Seattle, articulates a vision of how Seattle will grow in ways that sustain its citizens' values. The City first adopted the Plan in 1994 in response to the state Growth Management Act of 1990.

Multimodal transportation policies embedded in the Comprehensive Plan were used in the definition of system elements. In particular, transportation policies for transportation demand and system management strategies were used to guide the development of the project's Flexible Transportation Package definitions for each of the five Build Alternatives.

3.1.2 Destination 2030 Metropolitan Transportation Plan

The Destination 2030 Metropolitan Transportation Plan (MTP) is the adopted regional long-range transportation plan for the central Puget Sound region. The MTP comprises all transportation projects and programs planned for implementation by 2030 (funded and unfunded). The MTP also describes land use and socioeconomic conditions forecasted for 2030, which form the basis for the PSRC's travel demand models (the AWV travel demand model described in Chapter 2 is an enhanced version of the PSRC model).

The MTP describes the performance of the regional transportation system given implementation of the full complement of projects identified in the plan. As such, it illustrates the cumulative effects of implementing all of the transportation projects and programs that are planned throughout the region. Conversely, the analysis conducted for the Alaskan Way Viaduct and Seawall Replacement Study presumes only those projects that have secured funding and are presently programmed for implementation by 2030.

3.1.3 Sound Transit Sound Move Vision Plan

In 1996 voters approved funding for Sound Transit to provide a regional system of transit improvements, including Sounder commuter rail, ST Express regional bus service, numerous capital improvements (including park-and-ride lots, transit centers, and direct access ramps), and Link light rail. The plan that details this 10-year mix of projects and services is known as *Sound Move*.

The *Sound Move* plan provides input on transit service assumptions for Link Light Rail, Sounder Commuter Rail, and ST Express Bus Service to be operating in the greater downtown Seattle area. The transit investments approved in the *Sound Move* plan are included as part of the baseline definition for all Build Alternatives as well as the 2030 Existing Facility scenario.

3.1.4 King County Metro 6-Year Transit Development Plan

The King County Metro 6-year Capital Plan provides the framework for transit service and capital investments. The 6-year plan guides transit development in the years 2002 through 2007.

The 6-year Capital Plan was used to calculate projected annual transit service growth for the regional travel demand models, including Metro bus service, waterfront streetcar service, and transportation demand management strategies supplied by KC Metro.

3.1.5 Seattle Intermediate Capacity Transit Study (2001)

The Seattle Intermediate Capacity Transit Study examined a wide range of transit technologies and services that offer higher passenger carrying capacity and greater reliability than buses operating in mixed traffic. It included an assessment of transit services as follows:

- Bus Rapid Transit - buses that move quickly and reliably because of improvements such as transit-only lands or transit priority technology that gives buses a green light at intersections.
- Streetcars and Trams - electric vehicles running on rails in the streets.
- Elevated Transit (like monorail) - electric vehicles that are grade-separated or operate in exclusive rights-of-way, allowing them to avoid traffic congestion and other barriers.

The Intermediate Capacity Transit Study provided examination of transit system performance for various types of transit service that may operate in the AWV Corridor. Elevated transit networks were used in initial travel demand analyses to evaluate potential ridership from this type of system. This study was a precursor to the Seattle Popular Monorail Plan described below.

3.1.6 Seattle Popular Monorail Plan (August 2002)

The Seattle Popular Monorail Plan provided a blueprint for the 58-mile, five-line monorail system. In November 2003, voters approved funding for the design and construction of the initial segment of this plan. The Green Line would travel between West Seattle at the southern end to downtown and then to Ballard in the northern end.

Information from the plan helped to establish transit routing ridership assumptions for both the 14-mile Monorail Green Line and bus feeder system to monorail stations that were included in the travel demand modeling process.

3.1.7 Waterfront Parking Strategy Study (2002)

The Waterfront Parking Study was developed through a partnership between the City of Seattle Strategic Planning Office, the Seattle Aquarium, the Metropolitan Improvement District, the Pike Place Market Preservation & Development Authority, and the Port of Seattle. It was commissioned to develop a parking strategy to meet changing needs brought about by new and emerging land uses along the Seattle central waterfront area. The purpose of the strategy was to help the City balance the access and parking needs of a revitalized waterfront with preservation of neighborhood character and businesses.

Data from the study that was used in this project included inventories of waterfront area parking supply and forecasted changes to that supply, parking rates, and early identification impacts to parking based on the replacement of the Alaskan Way Viaduct.

3.1.8 Alaskan Way Viaduct Project: Task 1 Report (December 1996)

The Task 1 Report provides insights on travel characteristics of trips made on the Alaskan Way Viaduct. The report led to four distinct approaches (Framework Policies) for seeking a course of action.

Information from the report provided comparison information for the development of travel forecasts and traffic analysis activities.

3.1.9 Evaluation of Joint Operations in the Downtown Seattle Transit Tunnel (August 2001)

This joint Sound Transit/King County study examined the impact of removing downtown Seattle transit tunnel buses during the planned conversion of the downtown Seattle transit tunnel to joint bus/light rail operations. Of particular note was the impact to downtown streets of distributing tunnel buses to the downtown Seattle arterials for 2 years.

The information in this study will be helpful in the documentation of potential traffic impacts during construction, which is planned to take place around the same time of project construction.

3.1.10 Mercer Corridor/South Lake Union Transportation Study, Phase II (June 2003)

This current study by the City of Seattle is evaluating east–west arterial improvements in the South Lake Union area in support of the development of an Urban Village with 20,000 new jobs and 10,000 additional housing units.

3.1.11 City Center Circulation Plan (Ongoing - 2003)

The City of Seattle is conducting a study of transit and nonmotorized circulation and service options in the downtown area. The study is an effort to better integrate numerous independent transportation components and plans in the downtown area.

3.1.12 Washington State Highway System Plan 2003–2022 (February 2002)

The Washington State Highway System Plan 2003–2022 identifies needs and deficiencies on state highways. The plan involves coordinated efforts with other agencies to identify potential highway improvements.

3.2 Coordination

3.2.1 Transportation Interdisciplinary Team

A multi-agency Interdisciplinary Team (IDT) was established early in the project development to provide technical oversight to the project's traffic and transportation processes. The jurisdictions and agencies that were participants on the IDT included WSDOT (including Planning and Northwest Traffic), Washington State Ferries, City of Seattle, Federal Highway Administration (FHWA), King County (including Metro and Transportation Planning), and the PSRC.

Of particular concern to the IDT was how the plan alternatives were going to be evaluated from a transportation system performance perspective for the EIS. To address this, the MOEs evaluated in this study were compiled under the direction of the IDT. More information on how these measures are being applied can be found above in Chapter 2, Methodology.

In addition to the IDT, representatives from WSDOT Northwest Traffic and City of Seattle Department of Transportation (SDOT) Traffic Management met on a regular basis to review and provide feedback on the continuous evolution of traffic analysis for the plan alternatives.

3.2.2 Other Coordination

A working team made up of representatives of the City of Seattle, WSDOT, and King County Metro Market Development Department was convened to develop transportation demand and system strategy definitions for each of the plan alternatives. These strategies, referred to as Flexible Transportation Strategies, provide mostly low-cost transportation demand and systems management and human-powered strategies that are targeted at specific challenges or travel markets.

Specific ongoing coordination was conducted as needed with particular agencies that managed operations or had stakes in particular transportation modes. These included coordination with staff from King County Metro and Sound Transit for transit service and transportation demand management program development, Port of Seattle for freight operations, and the Washington State Ferries for vehicle and pedestrian access issues to/from Colman Dock.

This Page Intentionally Left Blank

Chapter 4 AFFECTED ENVIRONMENT

This chapter describes existing conditions (2002 analysis year) for transportation systems within the AWV study area. Information regarding current transportation facilities, their use, and their performance is presented. This information establishes an understanding of current conditions and serves as a basis against which projected future conditions for the 2030 Existing Facility and Build Alternatives can be compared.

4.1 Study Area and Regional Context

The Alaskan Way Viaduct and Seawall Replacement Project is a study of replacement alternatives for the SR 99 corridor through downtown Seattle. The project limits extend from S. Spokane Street in the south to north of Roy Street.

A transportation study area, which encompasses the project limits on SR 99, as well as nearby transportation facilities that are closely related to or affected by the SR 99 corridor, is shown in Exhibit 4-1. The study area is roughly bordered by I-5 to the east, Puget Sound to the west, Roy Street/Valley Street in the north, and S. Spokane Street in the south. It includes a range of multimodal transportation facilities and service types, including limited access highways, arterial streets, HOV facilities, transit services and facilities, ferry services and facilities, nonmotorized facilities and routes, and important freight corridors.

The transportation study area is located within downtown Seattle, a dense urban area that contains a major interstate freeway (I-5), two state routes (SR 99 and SR 519), arterial streets (primary, minor, and collector), and local streets. I-5 is a major state and regional facility and carries the majority of regional traffic through the study area, as well as considerable local traffic.

SR 99 parallels I-5 and serves important local and regional transportation functions. It provides access to downtown for many parts of the western neighborhoods of the City of Seattle and provides freight access between the Interbay/Ballard areas and the SODO (South of Downtown) and Duwamish industrial areas; it is an important alternative route to I-5, the most heavily used highway in the Pacific Northwest. SR 99 also provides an important link to major league sports stadiums at the south end of downtown and access to I-90 for trips coming from northwest Seattle.

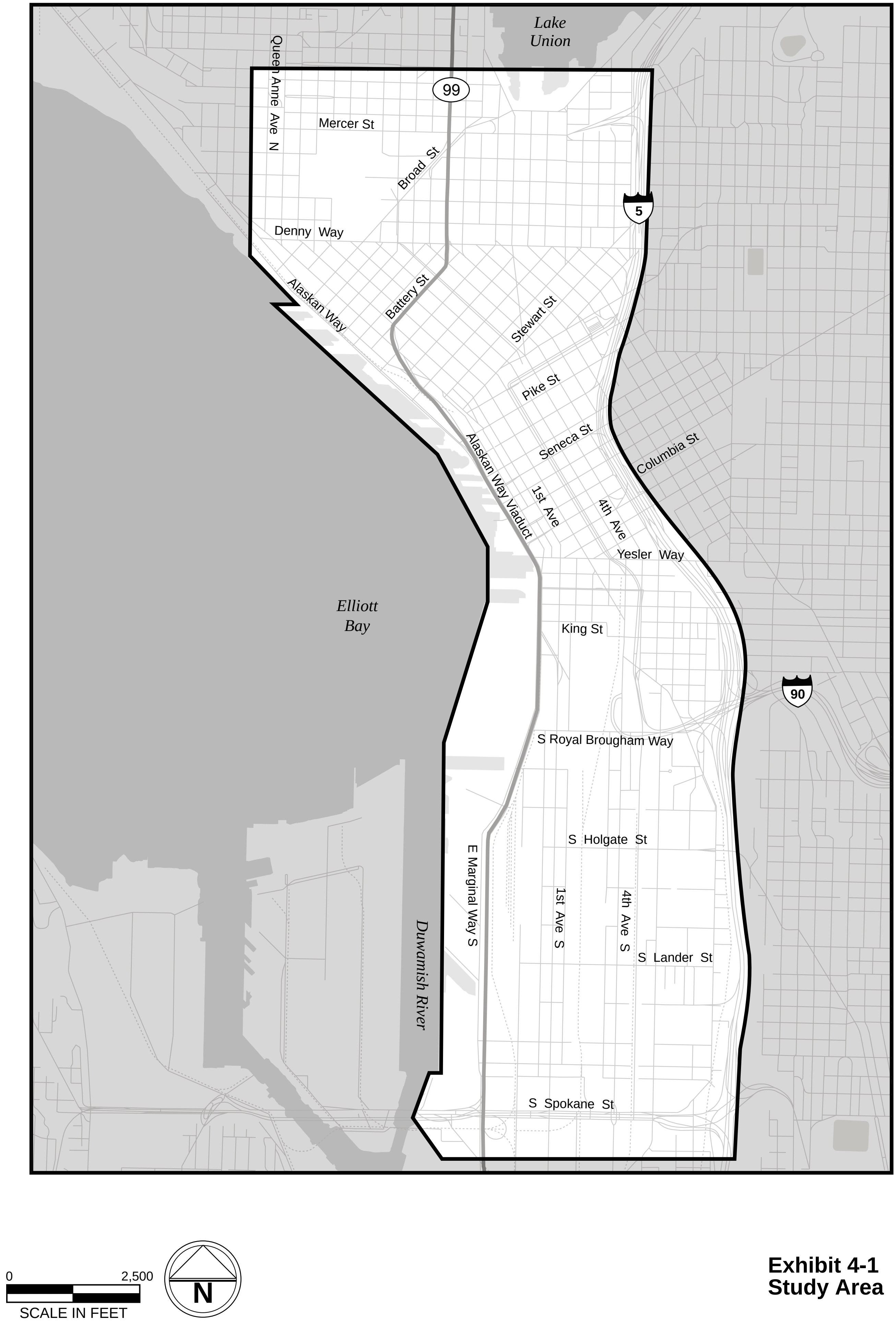


Exhibit 4-1
Study Area

The transportation study area establishes the area for which the transportation performance and impacts of the project alternatives are assessed. The most intensive evaluation of transportation performance and impacts is performed on SR 99 itself. Elsewhere in the study area, assessment focuses on capturing the important impacts and primary operational differences associated with alternatives. On occasion, information beyond the study area boundaries is provided to provide context for the data being presented.

4.2 Study Area Highways and Streets

This section summarizes the highway and street facilities in the project study area (Exhibit 4-2). SR 99, the project focus, is described in detail in Section 4.3. MOEs related to highway and arterial operations are assessed in Section 4.4. Other transportation facilities and modes are described in later sections, including transit (Section 4.5), freight (Section 4.6), ferry service (Section 4.7), nonmotorized transportation (Section 4.8), and parking (Section 4.9). In addition, information relating to highway safety is presented separately in Section 4.10.

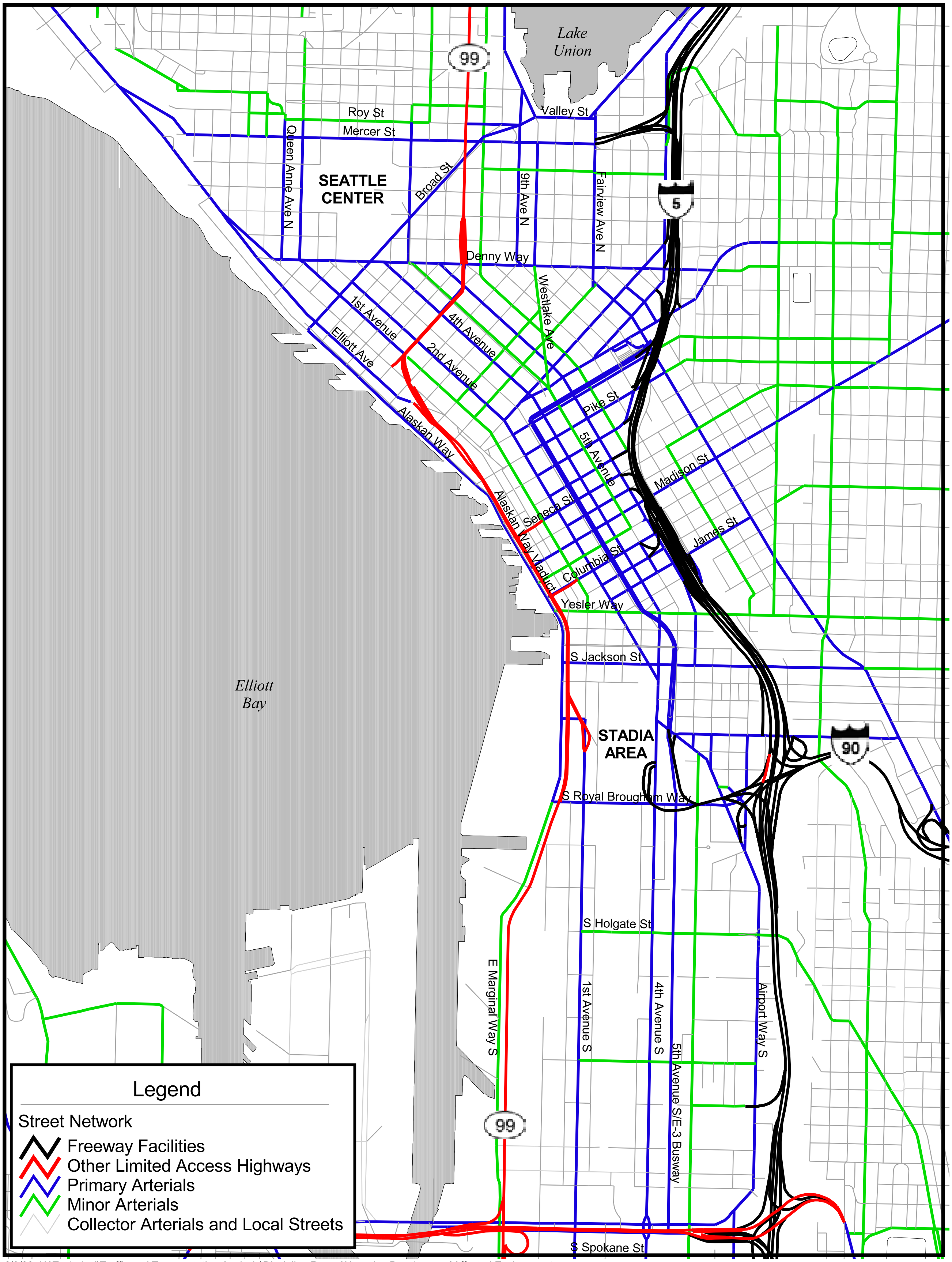
4.2.1 Urban Interstate Freeways

I-5 is a major Urban Interstate freeway that runs the length of the west coast from the Mexican border south of San Diego, California to the Canadian border north of Bellingham, Washington. I-5 is the most used and most important highway corridor in the region. Within the transportation study area, I-5 runs north–south just east of downtown. The corridor serves a number of roles, including freight transport, commuting, and longer-distance regional trips.

The roadway varies from two to five travel lanes in each direction, with additional collector-distributor lanes providing access to downtown ramps and accommodating merging traffic from I-90. Only two continuous lanes are provided through the downtown in each direction, as other lanes are added or dropped to provide access in downtown.

In addition to the mainline, a reversible set of express lanes provides HOV access to and from downtown, and additional through general-purpose capacity. This facility operates southbound during the morning commute and northbound at other times.

This Page Intentionally Left Blank



6/3/03 U:\Technical\Traffic and Transportation Analysis\Discipline Report\Narrative Development\Affected Environment

Source: City of Seattle

0 1250 2500 Feet

SCALE IN FEET

N

Figure 4-2
Street Network in the AWV Study Area

This Page Intentionally Left Blank

There are five interchanges on I-5 within the AWV study area. The I-5/I-90 interchange is by far the largest and most complicated of the interchanges, providing access to a number of arterials in south downtown, as well as the two interstates. A number of entrance and exit points are located between James and Stewart Streets that directly access downtown Seattle. The interchange at Mercer Street provides the main access point to the northern study area and South Lake Union.

4.2.2 Other Urban Expressways

Within the AWV study area, SR 99 is classified as an "Other Urban Expressway" and has been designated as part of the Washington State National Highway System. The roadway was designed in the 1940s and was open for traffic in 1953. SR 99 is an at-grade facility as it enters downtown Seattle from both the north and south. However, between S. Holgate Street and the Battery Street Tunnel, the viaduct is a double-level viaduct facility with two to four travel lanes available in each direction and no shoulders.

One full interchange and four partial interchanges are located within the study area, and there are a number of streets where drivers can access SR 99 via right-on and right-off maneuvers in the South Lake Union area. Greater detail on the SR 99 interchanges is provided in Section 4.3.

4.2.3 Arterial Streets

Nearly all of the downtown area streets are designated as either a principal or minor arterial. Principal arterials make up the majority of the central downtown area between Yesler Way and Denny Way. Principal arterials provide major north–south travelways, with a mixture of minor and collector arterials providing travel opportunities in the east and west directions.

While SR 99 is designated as an Urban Expressway and the majority of trips travel through the downtown area, approximately 38 percent of the vehicles that use AWV on a daily basis have one trip-end in downtown Seattle. Therefore, connections to the downtown street network are of considerable importance. Section 4.4.1 provides additional information regarding interchange access on SR 99 and the connections to the surrounding study area and roadway facilities.

4.2.4 HOV and Transit Facilities

A number of HOV facilities operate in the AWV study area, though none of these relate directly to the SR 99 corridor. Exhibit 4-3 provides a summary of study area HOV facilities.

Exhibit 4-3. Existing HOV Facilities and Treatments

Arterial	From	To	Treatment Description
I-5 Express Lanes	CBD	Northgate	Freeway HOV lane
I-90	I-90	Airport Way	Bus lane/HOV segment
Downtown Seattle Transit Tunnel	S. King Street	Stewart Street/ Ninth Avenue	Transit tunnel
E-3 Busway	Airport Way	Spokane Street	Transit facility
Second Avenue	Stewart Street	Yesler Way	Bus lane/HOV segment
Second Avenue Ext.	Yesler Way	Jackson Street	Bus lane/HOV segment
Fourth Avenue, Fourth Avenue S.	Yesler Way	Pike Street	Bus lane/HOV segment
Pine Street	Third Avenue	Fourth Avenue	Bus lane/HOV segment
SW Spokane Street	West of Chelan Ramp	Chelan/WSF ramp	Bus lane/HOV segment
Alaskan Way	North of Yesler Way	Yesler Way	Left-hand turn lane for transit
Howell Street	West of Ninth Avenue	Ninth Avenue	Queue-jump transit lane
Fairview Avenue N.	North of Valley Street	Valley Street	Left-hand turn lane for transit

Source: Seattle Department of Transportation.

Freeway (I-5) HOV Facilities

Within the study area, HOV lanes are provided on I-5 only on the reversible express lanes. These lanes carry both general-purpose and HOV traffic separately from the I-5 mainline and operate southbound in the morning and northbound in the afternoon. In addition to these facilities, HOV lanes are provided on I-5 outside of the study area north of Northgate and south of I-90.

Arterial HOV and Transit-Only Facilities

Several HOV facilities are provided on arterial streets in the study area. Many of these primarily facilitate transit movement through the downtown area (see Exhibit 4-3). None of the arterial HOV facilities link directly to the SR 99 corridor, though the southbound transit lane on Second Avenue and transit-only left turn pocket on Alaskan Way are located in close proximity to the AWV facility. Transit routing and use of these facilities is discussed in Section 4.5.

In addition to on-street arterial HOV facilities, the transit-only E-3 busway on Fifth Avenue S., between S. Spokane Street and S. King Street, provided transit access south of downtown between I-5 and the Downtown Seattle Transit Tunnel.

4.3 SR 99 Configuration and Traffic

4.3.1 The Alaskan Way Viaduct (SR 99) – Configuration

SR 99 is also a regional facility, but primarily serves shorter regional trips and intracity trips. Between S. Spokane Street and the Battery Street Tunnel, all access is provided via ramps. North of the Battery Street Tunnel, arterial connections to the SR 99 mainline provide access (right turn on/right turn off only). This section describes the SR 99 corridor through the study area.

Travel Lanes

The SR 99 facility comprises two or more general-purpose lanes in each direction through the study area. Exhibit 4-4 depicts the number of lanes on SR 99 throughout the corridor. Northbound, the SR 99 corridor carries three lanes from S. Spokane Street to the First Avenue S. ramps, four lanes to the Seneca Street off-ramp, and three lanes to the Western Avenue off-ramp. Two lanes continue northbound into the Battery Street Tunnel. Southbound, two lanes exiting the Battery Street Tunnel are joined by a third lane entering from Elliott Avenue. The three-lane southbound segment is carried through the corridor, merging to a two-lane segment south of S. Spokane Street. The Battery Street Tunnel operates with two lanes in each direction. Exiting the tunnel northbound, the highway is joined by two additional lanes from Denny Way. The four-lane segment continues to Mercer Street, where the outside lane is dropped to an off-ramp. The three-lane segment continues beyond the study area. In the southbound direction, three lanes are provided north of the Denny Way off-ramp at the Battery Street Tunnel. In this area north of the Battery Street Tunnel, the outside lane serves to collect and distribute right turning vehicles to side streets. Through movements are primarily accommodated in the inside lanes.

Access

Access and egress to SR 99 is provided at several locations. At S. Spokane Street, an eastbound to northbound on-ramp provides access from West Seattle, while in the opposing direction a southbound to westbound off-ramp provides for the reciprocal movement to the West Seattle high bridge. The southbound off-ramp also provides access to Harbor Island and the low-level West Seattle Bridge.

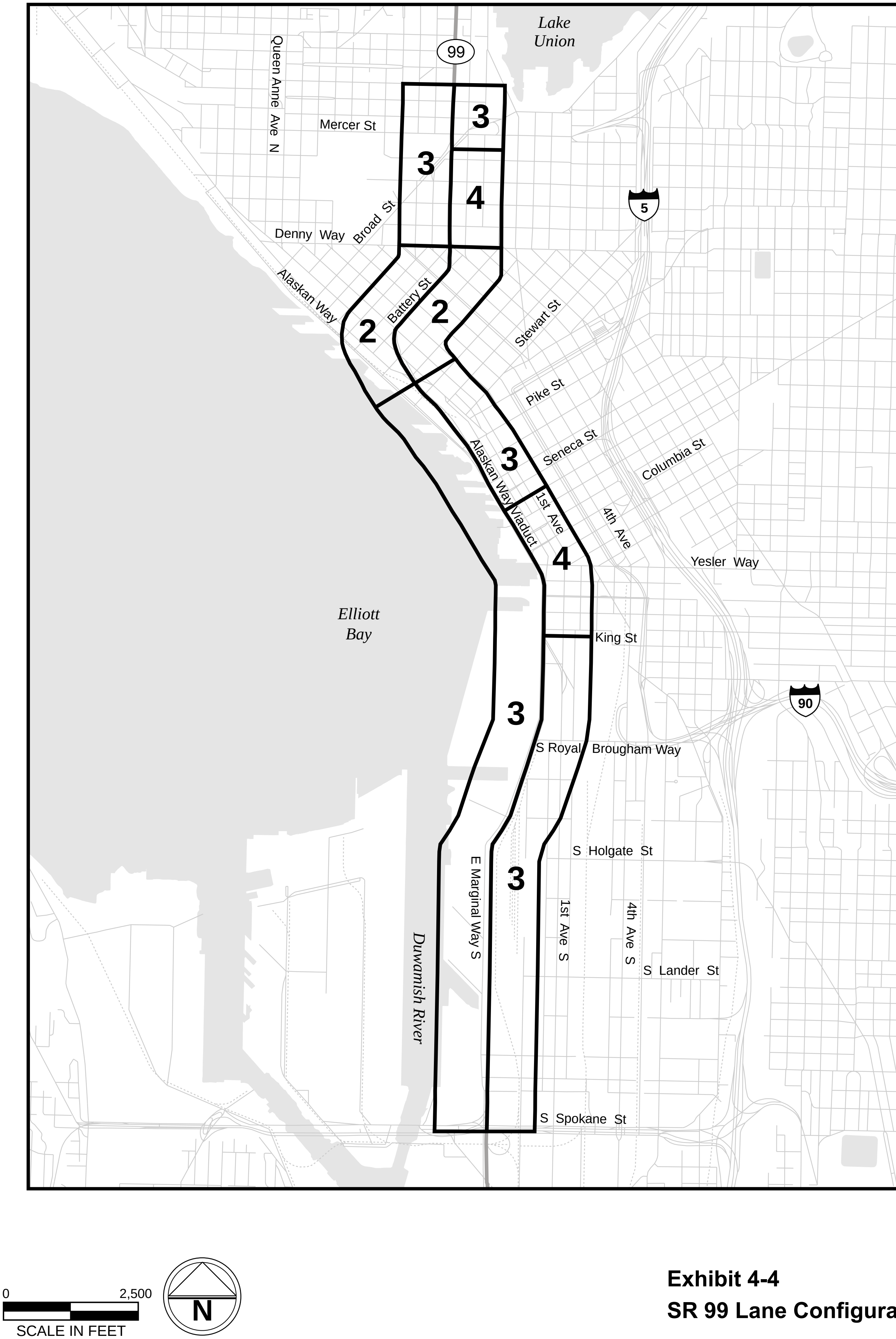


Exhibit 4-4
SR 99 Lane Configuration

Near the stadium area, ramps at First Avenue S. provide access to northbound SR 99 and egress from southbound SR 99. Connections to the south are not provided in this area. In downtown Seattle, a northbound off-ramp connects to Seneca Street, while an on-ramp from Columbia Street provides access from downtown to southbound SR 99. These midtown ramps provide access to the heart of downtown Seattle and the financial district and are also the downtown transit access point for routes traveling to and from the south. No direct access to and from the north is provided in the downtown area.

In the Belltown area, an interchange at Western Avenue and Elliott Avenue provides full access to north downtown, Pike Place Market, and the waterfront, as well as access to arterials connecting to Interbay, Lower Queen Anne, Magnolia, and Ballard. The roadway and ramp geometrics for the southbound off-ramp and northbound on-ramp, which are in close proximity to the Battery Street Tunnel portal, limit overall use of these ramps.

The Denny Way ramps provide access to north downtown and a variety of locations to the east and west of SR 99 (South Lake Union, Seattle Center, Queen Anne, the north waterfront and Port of Seattle facilities), and are also the transit access point for all routes traveling on the corridor between downtown and points north.

In the South Lake Union area, an off-ramp to Mercer Street provides direct access to the South Lake Union neighborhood for northbound traffic, while the Broad Street exit provides access to Seattle Center and Queen Anne for southbound traffic. Other access in the South Lake Union area is provided by a number of right-on and right-off access points connecting to the local street grid. No left turns or at-grade crossings of SR 99 are allowed. Access at these locations is somewhat limited because the side streets enter at right angles, requiring that drivers accelerate from a stopped position or decelerate considerably before exiting SR 99.

In summary, access to northbound SR 99 is provided at S. Spokane Street (from the West Seattle Bridge), First Avenue S., Western Avenue (geometrically constrained ramp at Bell Street), Denny Way, and by side street access in the South Lake Union area. Southbound trips can access SR 99 from side street access in the South Lake Union area, from Elliott Avenue at Blanchard Street, and from Columbia Street.

Vehicle egress from SR 99 is provided for northbound trips at Seneca Street, Western Avenue (at Blanchard Street), Mercer Street, and at side streets in the South Lake Union area. Southbound egress is provided at Broad Street and side streets in the South Lake Union area, Denny Way, Battery Street (this is a geometrically constrained ramp), and at First Avenue S. just north of S. Royal Brougham Way.

Design Constraints

The design of SR 99 in the study area is substandard in several locations. Throughout the study area, the mainline provides narrow travel lanes and limited shoulders. The Battery Street Tunnel includes tight curve and narrow travel lanes. In the southbound direction, the off-ramp at Western Avenue provides no deceleration lane and limited sight lines for vehicles using the ramp due to the sudden vertical drop upon exiting the mainline. The left-side on-ramp at Columbia Street includes a tight curve followed by a short acceleration lane. Finally, the left-side off-ramp at First Avenue S. provides a short deceleration lane. In the northbound direction, the off-ramp at Seneca Street includes a very tight curve upon leaving the mainline. Also northbound, the on-ramp to SR 99 at Battery Street merges immediately with the mainline without an acceleration lane and has limited sight distance.

Transport of combustible materials through the Battery Street Tunnel is prohibited at all times and also prohibited from the viaduct during peak commuting hours.

Speed Limits

Posted speed limits on the SR 99 mainline are shown in Exhibit 4-5.

Exhibit 4-5. Posted Speed Limits on SR 99

Mainline Segment	Posted Speed Limit (NB & SB)
North of Denny Way	40
Battery Street Tunnel	40 (35 advisory)
Elliott/Western Ramps to Seneca/Columbia Ramps	50
Seneca/Columbia Ramps to First Avenue S. Ramps	50
First Avenue S. Ramps to S. Spokane Street	50 (40 trucks)
South of S. Spokane Street	50

4.3.2 Corridor Travel Patterns

Daily

Mainline and Ramp Volumes

Daily traffic volumes on SR 99 are relatively balanced, with approximately 30,000 vehicles in each direction entering and exiting the central corridor to and from the north (through the Battery Street Tunnel) and approximately 40,000 vehicles in each direction entering and exiting the central corridor to and from the south.

In the southbound direction, 3,000 vehicles, approximately 10 percent of the daily volume in the tunnel, exit at Western Avenue. Immediately following the Western off-ramp, approximately 16,000 daily vehicles enter at Elliott Avenue, the largest entering volume in the corridor. In the downtown area, approximately 8,000 daily vehicles enter at Columbia Street. Finally, approximately 11,000 daily vehicles exit in the stadium area at First Avenue S. In the northbound direction, approximately 10,000 daily vehicles enter the mainline in the stadium area at First Avenue S. In the downtown area, approximately 9,000 daily vehicles exit at Seneca Street. The largest volume of exiting vehicles occurs at Western Avenue, where approximately 17,500 vehicles exit. Approximately 4,500 daily vehicles enter at Western Avenue. Existing daily traffic volumes on SR 99 and its access points are shown in Exhibit 4-6.

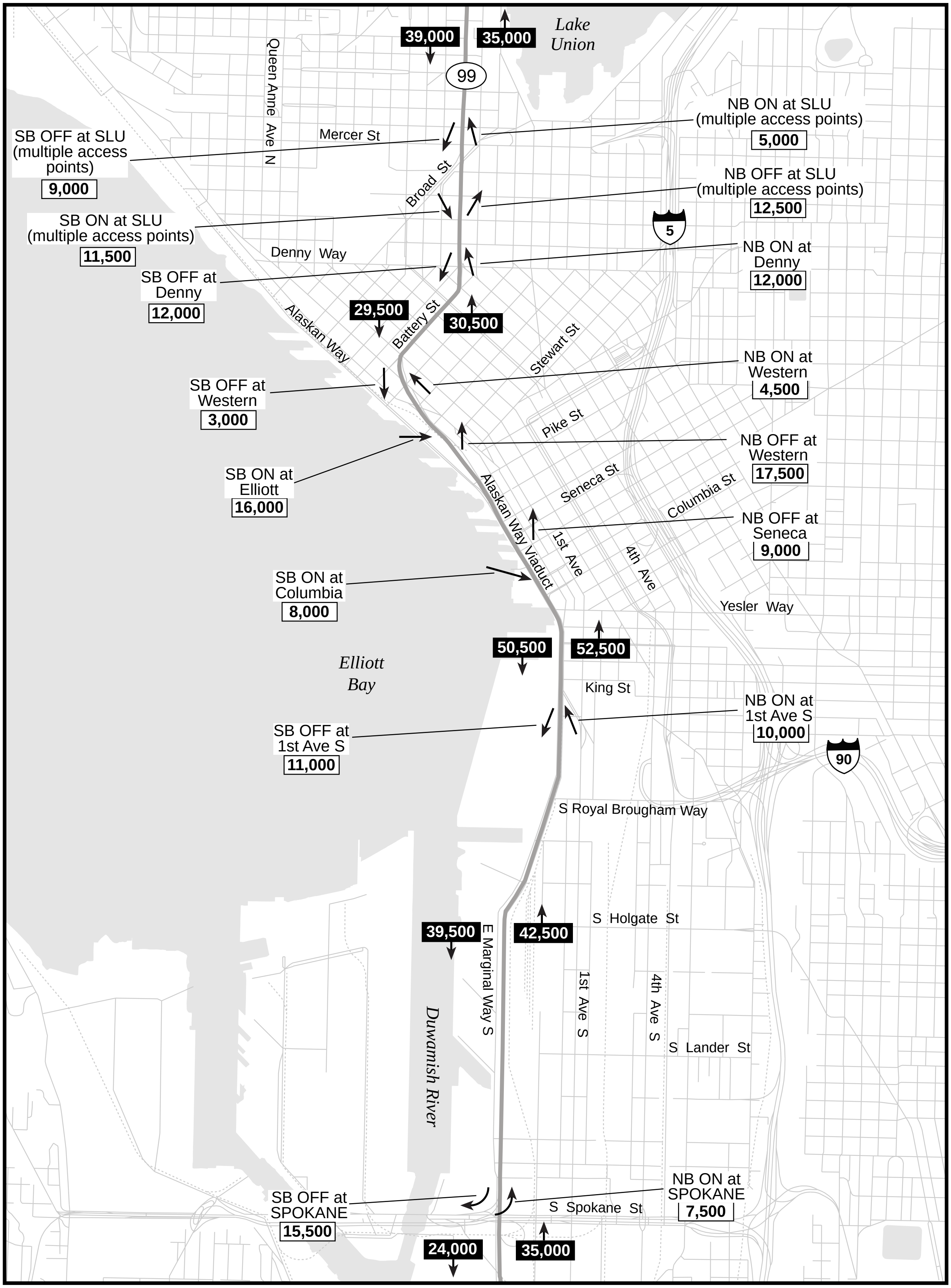
Travel Patterns

Travel patterns of SR 99 users are estimated based on existing traffic counts and travel demand modeling. Of the approximately 80,000 total daily vehicles entering and exiting the central corridor to and from the south, approximately 45 percent are trips through downtown that travel to and from the north via the Battery Street Tunnel, 20 percent enter and exit downtown at the Seneca and Columbia Street ramps, and 35 percent enter and exit at the Elliott/Western ramps. Of the approximately 60,000 daily vehicles that enter and exit the central corridor to and from the north via the Battery Street Tunnel, approximately 60 percent are through trips, 10 to 15 percent enter and exit at the Elliott/Western ramps, and 25 to 30 percent enter and exit at the First Avenue S. ramps. Daily travel patterns are summarized in Exhibits 4-7 and 4-8.

PM Peak Hour

Mainline and Ramp Volumes

Traffic volumes on the SR 99 corridor are highest during commuting hours. In the evening, peak hour traffic volumes on SR 99 are fairly directional, with heavier volumes leaving the central downtown. At the north end of the study area, PM peak hour mainline volumes are higher in the northbound direction, as more vehicles are leaving the downtown area (4,300 vehicles) than are entering it (3,200 vehicles). Northbound on-ramp volumes at Denny Way (1,470 vehicles) exceed those on the southbound off-ramp (680 vehicles). In the Battery Street Tunnel, the volume of northbound vehicles (3,050 vehicles) again exceeds the volume of southbound vehicles (2,600 vehicles). Ramps at Elliott/Western providing access to and from the north show directionality as well, with 500 vehicles entering northbound but only 300 vehicles exiting southbound. However, the ramps to and from the south are balanced, with 1,250 vehicles entering southbound and the same number exiting northbound.



0 2,500
SCALE IN FEET

N

XXX Ramp Volumes

XXX SR-99 Mainline Volumes

Exhibit 4-6
SR-99 Mainline and Ramp Volumes Existing Daily

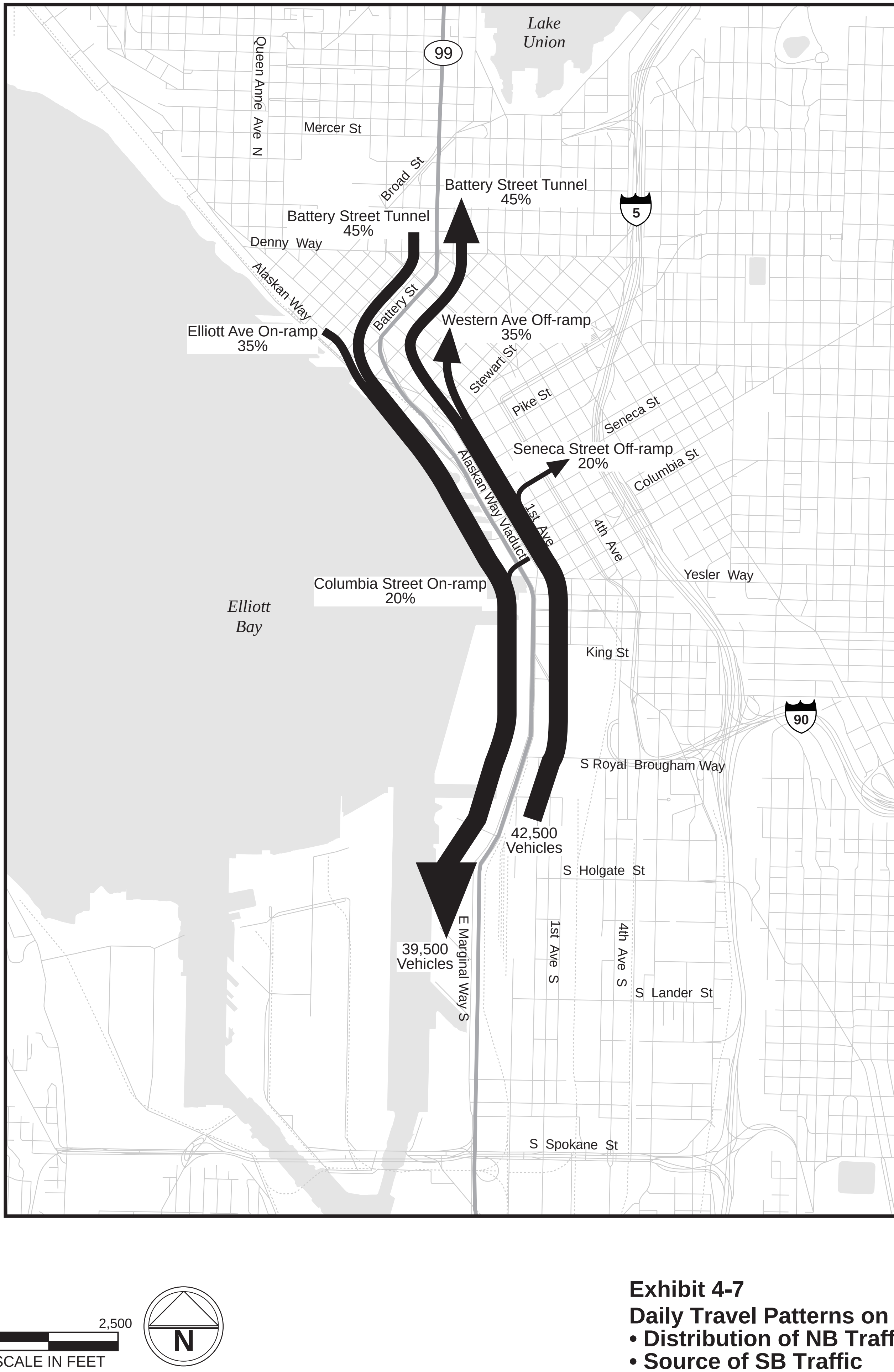


Exhibit 4-7
Daily Travel Patterns on SR-99
• Distribution of NB Traffic
• Source of SB Traffic

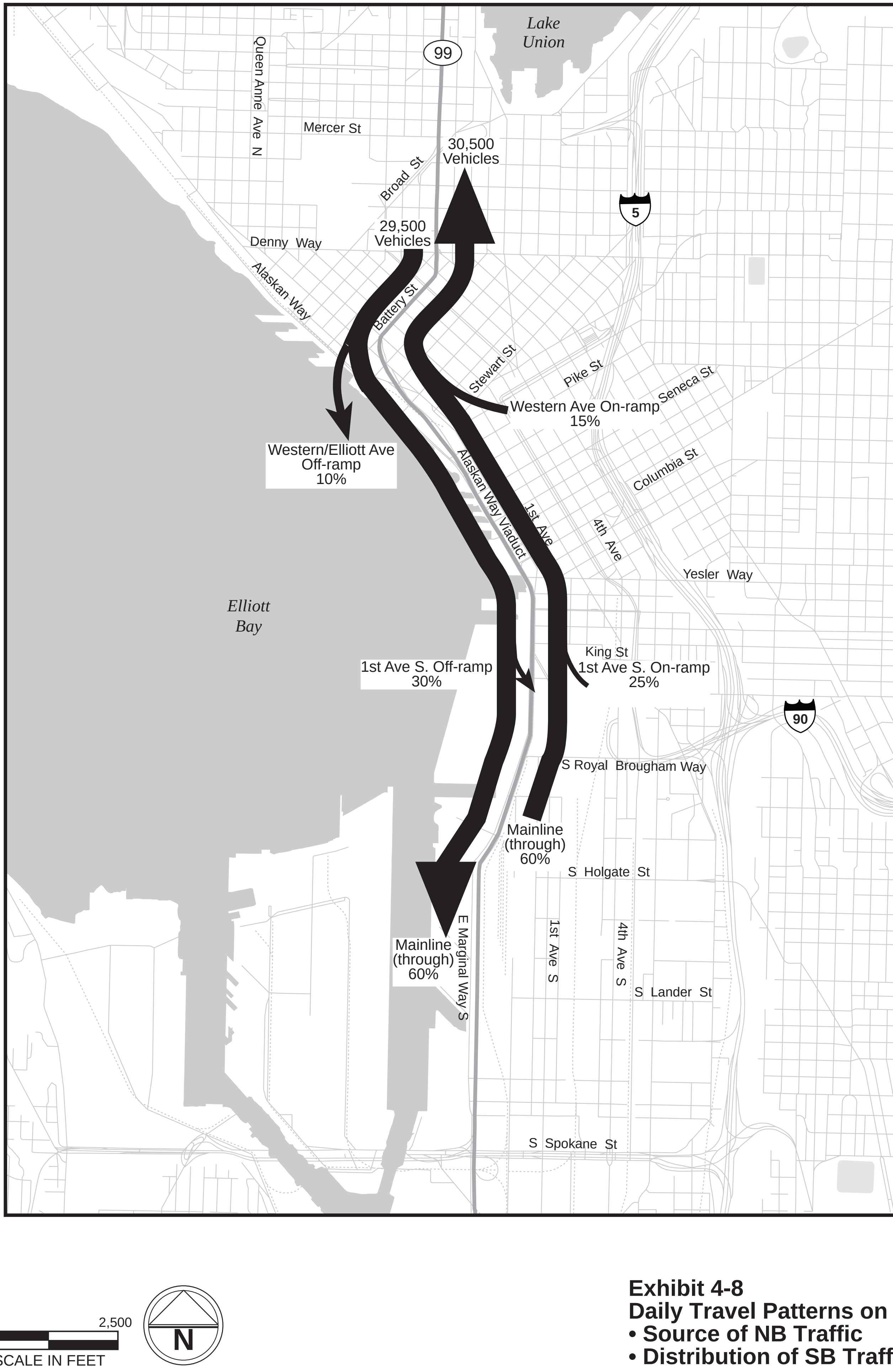


Exhibit 4-8
Daily Travel Patterns on SR-99
• Source of NB Traffic
• Distribution of SB Traffic

The downtown ramps providing access to and from the south show the opposite directionality as those to the north, with more vehicles entering southbound at Columbia Street (1,300 vehicles) than those exiting northbound at Seneca Street (650 vehicles). The First Avenue S. ramps show similar directionality, with 1,200 vehicles entering northbound but only 700 vehicles exiting southbound. South of downtown and the stadium area, mainline volumes are considerably higher in the southbound direction (4,100 vehicles) than the northbound direction (3,300 vehicles). At S. Spokane Street, volumes exiting southbound to West Seattle (1,750 vehicles) are almost double those entering northbound from West Seattle (950 vehicles). PM peak hour mainline and ramp volumes are shown in Exhibit 4-9.

4.4 Highway-Related Measures of Effectiveness

Several MOEs are presented to describe the operational characteristics of the SR 99 corridor and the broader transportation system. These measures summarize the results of transportation-related analyses conducted for the AWV Project and are presented for future Build Alternatives in subsequent chapters. Highway-related MOEs are presented in this section, while MOEs relating to transit, freight, pedestrians and bicycles, and safety are presented in subsequent sections.

4.4.1 Connections Provided to and from the SR 99 Corridor

MOE H1: SR 99 Connections

Exhibit 4-10 summarizes connections currently provided between SR 99 and other facilities. To summarize the quality of access the connections provide, a qualitative rating system grades the degree (full access, partial access, or no access) and quality of connections (ranging from direct ramp connections to indirect connections), resulting in a final rating of very good connectivity (represented by a full circle – ●) to no connectivity (empty circle – ○). Transit connections are addressed separately in Section 4.5. Details associated with the connections provided are presented in Exhibit 4-11.

To/From the Stadium Area

Access to and from the north only is provided in the stadium areas north of S. Royal Brougham Way at First Avenue S. A southbound off-ramp connects to southbound First Avenue S., while an on-ramp from northbound First Avenue S. provides access to northbound SR 99. No connection to southbound SR 99, or from northbound SR 99, is provided. The closest connection for travelers to or from the south are the midtown ramps at Columbia and Seneca Streets, over one-half to three-quarters of a mile away.

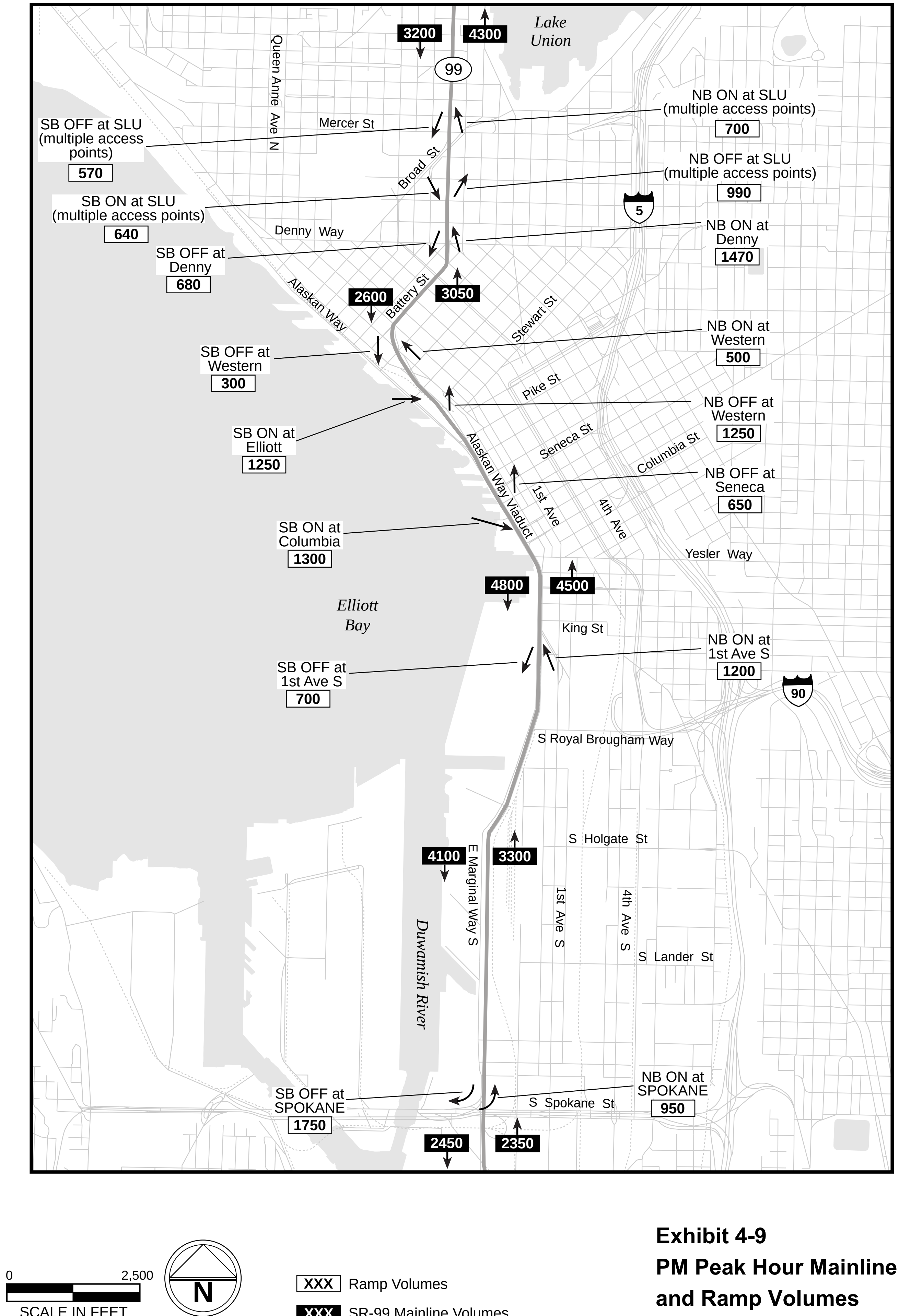


Exhibit 4-9
PM Peak Hour Mainline and Ramp Volumes Existing Conditions

Exhibit 4-10. Summary of Existing Connections Provided To/From the AWV

	Existing
Stadium Area	◑
Southbound SR 99 to Stadium Area	Good
Stadium Area to Southbound SR 99	None
Northbound SR 99 to Stadium Area	None
Stadium Area to Northbound SR 99	Good
Downtown Seattle	◑
Southbound SR 99 to Downtown	None
Downtown to Southbound SR 99	Good
Northbound SR 99 to Downtown	Fair
Downtown to Northbound SR 99	None
Elliott and Western Corridor	◕
Southbound SR 99 to Elliott/Western	Fair
Elliott/Western to Southbound SR 99	Good
Northbound SR 99 to Elliott/Western	Good
Elliott/Western to Northbound SR 99	Fair
South Lake Union Area	◑
Southbound SR 99 to west South Lake Union	Good
Southbound SR 99 to east South Lake Union	Good
West South Lake Union to Southbound SR 99	Fair
East South Lake Union to Southbound SR 99	Poor
Northbound SR 99 to west South Lake Union	Poor
Northbound SR 99 to east South Lake Union	Good
West South Lake Union to Northbound SR 99	Fair
East South Lake Union to Northbound SR 99	Fair

Exhibit 4-11. Existing Connections – Details

	Good Access	Partial or Substandard Access	No Access
Stadium Area			
SB SR 99 to Stadium Area	First Avenue Ramp (SB only)		
Stadium Area to SB SR 99			None
NB SR 99 to Stadium Area			None
Stadium Area to NB SR 99	First Avenue Ramp (NB only)		
Downtown Seattle			
SB SR 99 to Downtown			None
Downtown to SB SR 99	Columbia Street Ramp		
NB SR 99 to Downtown		Seneca Street Ramp (substandard)	
Downtown to NB SR 99			None
Elliott and Western Corridor			
SB SR 99 to Elliott/Western		Battery Street Ramp (substandard)	
Elliott/Western to SB SR 99	Elliott Avenue Ramp		
NB SR 99 to Elliott/Western	Western Avenue Ramp		
Elliott/Western to NB SR 99		Battery Street Ramp (substandard)	
South Lake Union Area			
SB SR 99 to west SLU	Denny Way Ramp Broad Street Ramp	Arterial Connections	
SB SR 99 to east SLU	Denny Way Ramp	Broad Street Ramp (via Mercer Street)	
West SLU to SB SR 99		Arterial Connections	
East SLU to SB SR 99			Indirect
NB SR 99 to west SLU			Indirect
NB SR 99 to east SLU	Mercer/Dexter Ramp	Arterial Connections	
West SLU to NB SR 99		Arterial Connections (via Mercer Street)	
East SLU to NB SR 99		Arterial Connections	

NB = northbound; SB = southbound; SLU = South Lake Union

To/From Downtown Seattle

Access from northbound SR 99 is provided into downtown via an off-ramp at Seneca Street. An on-ramp at Columbia Street provides access to southbound SR 99. These ramps provide direct connections to downtown Seattle, but are low speed and do not provide adequate acceleration or deceleration lanes. No direct access from downtown is provided onto northbound SR 99 or off southbound SR 99. Traffic in downtown that utilizes SR 99 north of downtown must use the Western ramps or Denny ramps north of downtown.

To/From Elliott and Western Area

Full connections between SR 99 and the local street system are provided just south of the Battery Street Tunnel by ramps at Elliott Avenue and Western Avenue. While full access is provided to Elliott and Western Avenues, the existing southbound off-ramp and northbound on-ramp have geometric deficiencies and are not heavily used.

To/From South Lake Union Area

Connections in the South Lake Union area north of the Battery Street Tunnel are provided by direct side-street connections (right on, right off only), as well as northbound and southbound off-ramps to Broad Street. Arterial connections across SR 99 are limited, which hampers not only local traffic, but also accessibility to SR 99. Access in all directions is possible, though some movements are very indirect. In particular, vehicles on the east side of the SR 99 corridor cannot easily access southbound SR 99, nor can vehicles on northbound SR 99 easily access areas on the west side of the SR 99 corridor.

4.4.2 PM Peak Hour Travel Times

MOE H2: Corridor PM Peak Hour Travel Times

Existing peak hour travel times for important routes that use the SR 99 corridor were estimated. These routes represent the major movements accommodated by the SR 99 corridor and include mainline segments, ramps, and arterials as necessary to fully traverse each route. The routes selected extend beyond the transportation study area boundary to better represent the total travel times that actual trips might experience. This allows the relative difference in travel times to be considered in context with the total travel times for longer distance trips (those originating or destined to locations outside of the study area). The procedures used to estimate travel times and further detail on route definitions are presented in Chapter 2, Methodology.

Exhibit 4-12 shows travel times for each route.

Exhibit 4-12. Existing (2002) PM Peak Auto Travel Times for Selected Routes

	Southbound (minutes)	Northbound (minutes)
Aurora Bridge - Spokane Street	8	9
Ballard Bridge - SR 519 (Stadium Area)	12	16
Aurora Bridge - Seattle CBD	15	12
Seattle CBD - S. Spokane Street	8	10

Between S. Spokane Street and the Aurora Bridge

This route, which represents through trips on the SR 99 corridor, follows SR 99 between S. Spokane Street and the Aurora Bridge. The results of the PM peak hour travel time analysis show that northbound (9 minutes) and southbound (8 minutes) PM peak hour travel times are similar. Simulation modeling showed congested but steady operations on the mainline in both directions under average PM peak hour volumes.

Between SR 519 and Ballard Bridge

Trips to and from the Interbay, Magnolia, and Ballard areas are represented by this route, which follows SR 99 from the First Avenue S. ramps to the Elliott/Western ramps. From there, the route follows Elliott Avenue (southbound) or Western Avenue (northbound) to Denny Way and on to 15th Avenue W. north. PM peak hour northbound travel time (16 minutes) is higher than southbound (12 minutes) due to the congestion at the Western Avenue off-ramp.

Between Downtown Seattle and the Aurora Bridge

This route measures travel time between a fixed point in downtown (vicinity of Second Avenue and Madison Street) and the Aurora Bridge in the north. The route is not directly served by ramps in the downtown, so vehicles using this route must enter or exit at the Denny ramps and use surface arterials to reach downtown. Southbound travel times were especially long (15 minutes), encountering some delay as SR 99 approaches the Denny ramps and very high delays on arterials in downtown (particularly on Second Avenue). Northbound travel times were shorter (12 minutes), as less delay was encountered on arterials exiting the downtown.

Between S. Spokane Street and Downtown Seattle

This route measures travel time between SR 99 at S. Spokane Street (south of downtown) and a fixed point in downtown (vicinity of Second Avenue and Madison Street). The route is fairly directly served by the Seneca Street off-ramp and Columbia Street on-ramp in downtown. Northbound travel times

(10 minutes) are higher than southbound (7 minutes) due to delay at the Seneca Street off-ramp, and some out of direction travel is required to reach the vicinity of Second Avenue and Madison Street from the Seneca Street off-ramp.

4.4.3 Corridor Throughput

MOE H3: SR 99 Corridor Vehicle Throughput

Vehicle throughput is a measure of the number of vehicles traversing past a fixed point. Five primary segments on the SR 99 mainline were reviewed:

- North Corridor – Entering/exiting at the north study area limits (north of Roy Street).
- Battery Street Tunnel – In the Battery Street Tunnel.
- North Downtown – SR 99 segment between the ramps at Elliott/ Western and the downtown ramps (to Seneca northbound, and from Columbia southbound).
- South Downtown – SR 99 segment between ramps to/from downtown Seattle (to Seneca northbound and from Columbia southbound) and the First Avenue S. ramps.
- South Corridor – Segment between the First Avenue S. ramps and S. Spokane Street.

As shown in Exhibit 4-13, SR 99 accommodates similar PM peak hour vehicle volumes on the north and south corridors. Much of the north corridor traffic is destined to or originates from the South Lake Union area, as volumes in the Battery Street Tunnel are 25 percent lower than those to the north. The Battery Street Tunnel acts as a capacity constraint on the corridor (having only two lanes with slower speeds in each direction), which is reflected in the vehicle throughput. Vehicle throughput peaks in the south downtown segment, where trips from First Avenue S. and the downtown ramps are both utilizing the corridor.

Exhibit 4-13. Existing (2002) PM Peak Vehicle Throughput on SR 99

	Existing (2002)
North Corridor	7,500
Battery Street Tunnel	5,650
North Downtown	7,400
South Downtown	9,300
South Corridor	7,400

MOE H4: SR 99 Corridor Person Throughput

Person throughput is a similar measure to vehicle throughput, except that it measures the number of persons, rather than vehicles, being carried by SR 99. Therefore, use of the corridor by transit or HOVs can dramatically increase the person carrying capacity relative to the vehicle carrying capacity. Exhibit 4-14 summarizes the estimated current person throughput for the same corridor segments analyzed for vehicle throughput. Similar to vehicle throughput results, person throughput is lowest through the Battery Street Tunnel. Additionally, the adjacent north downtown segment also shows lower person throughput than the outer segments, which is a result of the absence of transit services on this and the Battery Street Tunnel segments. Transit services that use SR 99 do not use these central segments, but instead travel through the outer corridor segments, enter or exit SR 99 downtown or at Denny Way, and circulate through downtown Seattle on surface arterials. The result is that the outer segments of the SR 99 corridor carry considerably more people (16 to 50 percent) than the central segments do, even though the relative difference in vehicles carried for these segments was smaller.

Exhibit 4-14. Existing (2002) PM Peak Person Throughput on SR 99

	Total Person Throughput	Auto Drivers and Passengers	Transit Riders
North Corridor	11,800	10,000	1,800
Battery Street Tunnel	7,500	7,500	0
North Downtown	9,850	9,850	0
South Downtown	14,900	12,350	2,550
South Corridor	12,400	9,850	2,550

4.4.4SR 99 Demand and Capacity

MOE H5: Corridor Volume/Capacity Estimates

Volume to capacity (V/C) ratio is an estimate of the amount of roadway capacity used during peak traffic conditions. This measure can help identify where more lanes may be required to accommodate demand, or conversely, where more lanes than necessary may be provided. A V/C over 100 percent indicates a segment where the traffic entering the segment exceeds the capacity provided. Capacity is measured in terms of number of lanes available for traffic and an estimated hourly capacity per lane. The procedures and assumptions used are detailed in Chapter 2, Methodology.

Exhibit 4-15 summarizes V/C percentages for major segments of SR 99. None of the corridor segments operate at or near capacity, which indicates that additional lanes are not necessary to accommodate current demand. This information also suggests that congestion experienced on the corridor is most likely a result of interaction with traffic entering and exiting the corridor or localized geometric constraints, neither of which is reflected in this basic evaluation of capacity.

Exhibit 4-15. Existing (2002) PM Peak Hour SR 99 Volume to Capacity Estimates

	Southbound	Northbound
North Corridor	56%	75%
Battery Street Tunnel	68%	80%
North Downtown	56%	61%
South Downtown	76%	54%
South Corridor	59%	48%

MOE H6: Hours of Congested Operations

Except for cases of incidents or weather-related congestion, the existing corridor typically operates under congested conditions for less than one hour per day in each direction. Congestion generally forms at the Western off-ramp northbound and at the Columbia on-ramp southbound.

4.4.5 SR 99 Mainline Traffic Operations

MOE H7: SR 99 Mainline Levels of Service and Speeds

Mainline traffic performance was modeled using CORSIM simulation software. Current PM peak hour LOS estimates for mainline segments were calculated based on simulation results for the SR 99 mainline and are presented in Exhibit 4-16. The LOS results indicate that both the north and south end of the corridor are operating at reasonable levels of service (i.e., LOS D or better). However, in the northbound direction, the Elliott/Western area is operating near or at capacity (LOS E from the Western off-ramp to Elliott on-ramp, and LOS F in the Battery Street Tunnel). The Midtown area is operating at LOS D or E in both the northbound and southbound directions.

The existing 2002 PM peak segment speed results are shown in Exhibit 4-17 below. These may be compared with the posted speed limits (see Exhibit 4-5) to gauge the level of delay experienced on the mainline during the PM peak hour. The posted speed on the northbound mainline is 50 mph between E. Marginal Way and the Western Avenue off-ramp. North of the Western Avenue off-ramp, the posted speed drops to 40 mph. The posted speed remains at 35 mph to the north end of the project limits. The southbound posted speed limit is 40 mph from the north end of the project to the Western Avenue off-ramp, where it increases to 50 mph.

Exhibit 4-16. Existing (2002) PM Peak Hour SR 99 Segment LOS

Southbound		Northbound	
North Corridor			
North of Battery Street Tunnel	A	B	North of Battery Street Tunnel
Battery Street Tunnel			
Battery Street Tunnel	E	F	Battery Street Tunnel
Western Off to Elliott On (SB)	D	E	Western Off to Western On (NB)
Midtown			
Elliott On to Columbia On (SB)	D	E	Seneca Off to Western Off (NB)
Columbia On to First Avenue S. Off (SB)	E	D	First Avenue S. On to Seneca Off (NB)
South Corridor			
First Avenue S. Off to S. Spokane Street	D	C	S. Spokane Street to First Avenue S.

Exhibit 4-17. Existing (2002) PM Peak Hour SR 99 Segment Speeds

	Speed Limit	Southbound	Northbound
North Corridor	40	39	33
Battery Street Tunnel and Western/Elliott Area	40	34	33
Midtown	50	41	39
South Corridor	50	44	46

Southbound mainline peak-hour speeds are slower than, but within 10 mph of, the posted speeds. The average speed in the midtown area is estimated at 41 mph, compared to the posted speed limit of 50 mph, due to mixing of traffic from the southbound Columbia on-ramp. Northbound speeds are again slower than, but fall within 7 mph of, posted speeds. Congestion forming at the Seneca and Western exits slows traffic in the midtown and Battery Street Tunnel areas. For both northbound and southbound traffic, the slowest speeds are encountered in the Battery Street Tunnel area.

4.4.6 Distribution of Traffic by Facility

MOE H8: Traffic Distribution

Exhibit 4-18 depicts the modeled distribution of daily traffic on north–south oriented highways and streets entering the study area from the north and south, as well as in downtown Seattle. I-5 carries the majority of traffic through the study area, approximately 60 percent in the downtown area. SR 99 carries about 23 percent of traffic in the downtown area, while the local streets in downtown combined also carry approximately 17 percent of daily north-south traffic.

Exhibit 4-18. Existing (2002) Daily Traffic Distributions

	Existing Daily Volume
North–South Arterials (Except Alaskan Way)	
North (Roy Street)	133,000
Downtown (Marion Street)	79,000
South (S. Spokane Street)	151,000
I-5	
North (Roy Street)	322,000
Downtown (Marion Street)	288,000
South (S. Spokane Street)	271,000
Alaskan Way	
North (Roy Street)	N/A
Downtown (Marion Street)	9,000
South (S. Spokane Street)	N/A
SR 99	
North (Roy Street)	61,000
Downtown (Marion Street)	103,000
South (S. Spokane Street)	86,000
Total Volumes	
North (Roy Street)	516,000
Downtown (Marion Street)	479,000
South (S. Spokane Street)	508,000

North and south of downtown, SR 99's share of traffic decreases relative to local streets or I-5. Even so, SR 99 carries more traffic than any single facility in the study area other than I-5.

4.4.7 Arterial Traffic Operations

MOE H9: Arterial Intersections Performance

Traffic operations at signalized intersections in the study area were assessed to determine intersection level of service (LOS), average vehicle delay, and intersection capacity utilization (ICU). ICU is a measure reported by the software analysis program Synchro that can be thought of as an equivalent to the more traditional V/C ratio. It represents the percentage of basic intersection capacity used by the traffic volumes estimated to use the intersection. ICU is based on the geometric capacity provided only (i.e., the capacity considered is independent of signal timing).

Intersections that are projected to operate with especially long delays or overcapacity during the PM peak hour are identified as "congested intersections." These intersections are those that operate under LOS F conditions (average vehicle delay of greater than 80 seconds) or ICU greater than 100 percent. Congested intersections are further identified as "highly congested" if they exceed 110 seconds of average vehicle delay and have an ICU of greater than 110 percent, or "moderately congested" if they fall below those criteria.

The intersections analysis results are presented for four sub-areas:

- South (Stadium Area)
- Central
- North Waterfront
- North (South Lake Union)

Ten intersections were found to operate at congested conditions during the PM peak hour, though none were identified as being highly congested (Exhibit 4-19). Results by sub-area are detailed below.

Exhibit 4-19. Congested Intersections by Sub-area

	Street	2002 Existing
South	*Moderately Congested*	*0*
	Highly Congested	*0*
	South Area Congested Intersections	0
Central	*Moderately Congested*	*7*
	Highly Congested	*0*
	Central Area Congested Intersections	7
North Waterfront	*Moderately Congested*	*0*
	Highly Congested	*0*
	North Waterfront Area Congested Intersections	0
North	*Moderately Congested*	*3*
	Highly Congested	*0*
	North Congested Intersections	3
Total	*Moderately Congested*	*10*
	Highly Congested	*0*
	Total Congested Intersections	10

South

Exhibit 4-20 presents traffic operations for intersections in the south area near the stadiums. No intersections are identified as congested, though the intersection of First Avenue and S. Royal Brougham Way is very close to meeting the moderately congested criteria, with an LOS of E and ICU of 98 intersections. Note that this analysis was conducted for conditions prior to implementation of the SR 519 Phase I project. The SR 519 project will connect First Avenue S. and Fourth Avenue S. at Atlantic Street with a new grade-separated crossing of the BNSF rail lines. This improvement will increase east-west capacity in the area and redistribute some traffic from S. Royal Brougham Way to S. Atlantic Street.

Central

Exhibit 4-21 below shows PM peak hour signalized intersection LOS and ICU for selected signalized intersections in the downtown and portions of Belltown. These include intersections on First Avenue S., Second Avenue, Alaskan Way, Elliott Avenue, and Western Avenue. The following intersections were found to meet the criteria for congested operations:

- Alaskan Way and Marion Street
- Alaskan Way and Yesler Way
- First Avenue and Madison Street
- First Avenue and Columbia Street
- Second Avenue and Spring Street
- Second Avenue and Madison Street
- Second Avenue and Marion Street

None of these intersections were identified as highly congested, though several met either the delay or the capacity threshold required for such designation. The intersections on Second Avenue all showed very high levels of delay, but ICUs in the range of 88 to 100 percent. These intersections carry very high vehicle volumes during the PM peak hour and also experience high conflicting pedestrian volumes, bus traffic in the right lane, and heavy conflicting movements on cross streets. Review of current signal timing indicates that reduction in intersection delay could be realized if predominant movements (north–south) were allotted a larger share of green time, though issues associated with the short storage lengths on east–west streets could limit the ability to implement such changes. Even with signal timings optimized to minimize delay, the improvement would not be sufficient to result in LOS of better than F.

Of the congested intersections downtown, all except Alaskan Way at Marion Street operate at LOS F conditions. Four were found to operate beyond their estimated capacity (ICU values over 100 percent):

- Alaskan Way and Marion Street
- Alaskan Way and Yesler Way

- First Avenue and Columbia Street
- Second Avenue and Madison Street

Of these intersections, the intersection of Alaskan Way and Marion Street is severely congested during periods of ferry unloading, as Marion Street is a primary egress point for Colman Dock. LOS D is reported for overall operations at this intersection, however, as traffic does not experience high levels of delay during periods when ferry traffic is not exiting Colman Dock.

North Waterfront

Exhibit 4-22 summarizes intersection operations on the waterfront north of downtown. For existing conditions, the signalized intersection of Elliott Avenue at Broad Street was analyzed. No operational problems were found for the PM peak hour. Several nearby intersections are assessed in the north and central sub-areas as well.

North

Exhibit 4-23 summarizes existing 2002 PM peak intersection operations for the intersections in the north sub-area. Three intersections operate at congested conditions:

- Elliott Avenue and Western Avenue (extension of Denny Way)
- Second Avenue and Denny Way
- Dexter Avenue and Denny Way

Elliott Avenue at Western Avenue (north of Denny Way) is a heavily traveled intersection. Analysis indicates LOS F and overcapacity (ICU 105 percent) operations during the PM peak hour. The intersection of Denny Way and Second Avenue was also found to operate overcapacity, with ICU of 111 percent, though an LOS C result indicates acceptable operations. This intersection accommodates left turning vehicles from the mainline, though it does not have left turn pockets or a protected signal phasing. Under current traffic levels, enough gaps exist on Denny Way to allow the left turn movements, hence the acceptable LOS. Similarly, the reported LOS for the Dexter Avenue/Denny Way intersections does not indicate poor traffic operations, though the ICU measure shows that the intersections operate at overcapacity conditions. This finding is also likely due to the absence of a left turn lane, which affects the capacity measure, but does not affect overall delay calculations to a great degree at current volumes.

Exhibit 4-20. Existing (2002) PM Peak Hour Detailed Traffic Operations, South

Street	Cross Street	Identified as Congested	LOS	Avg Veh Delay	ICU
Alaskan Way	S. Royal Brougham Way	-	C	21	55%
First Avenue	S. Royal Brougham Way	-	E	74	98%
First Avenue	S. Atlantic Street	-	B	17	77%
	Moderately Congested Intersections	0			
	Highly Congested Intersections	0			
	Total Congested Intersections	0			

MC Moderately Congested Intersections (LOS F or ICU > 100%)
HC Highly Congested Intersections (Delay > 110 seconds per vehicle <u>and</u> ICU > 110%)

Exhibit 4-21. Existing (2002) PM Peak Hour Detailed Traffic Operations, Central

Street	Cross Street	Identified as Congested	LOS	Avg Veh Delay	ICU
Alaskan Way	Madison Street	-	D	52	81%
Alaskan Way	Marion Street	MC	D	43	125%
Alaskan Way	Columbia Street	-	D	47	65%
Alaskan Way	Yesler Way	MC	F	80	104%
Alaskan Way	S. Main Street	-	B	11	66%
Alaskan Way	S. Jackson Street	-	A	2	71%
Western Avenue	Wall Street	-	C	31	92%
Western Avenue	Battery Street	-	B	12	62%
Western Avenue	Spring Street	-	B	11	71%
Western Avenue	Madison Street	-	B	12	55%
Western Avenue	Marion Street	-	B	14	59%
First Avenue	Seneca Street	-	B	19	77%
First Avenue	Spring Street	-	D	37	85%
First Avenue	Madison Street	MC	F	82	67%
First Avenue	Marion Street	-	C	21	85%
First Avenue	Columbia Street	MC	F	89	119%
First Avenue	S. Main Street	-	C	21	57%
First Avenue	S. Jackson Street	-	C	26	75%
Second Avenue	Spring Street	MC	F	192	92%
Second Avenue	Madison Street	MC	F	141	100%
Second Avenue	Marion Street	MC	F	145	88%
Second Avenue	Columbia Street	-	D	44	84%
	Moderately Congested Intersections	7			
	Highly Congested Intersections	0			
	Total Congested Intersections	7			

MC Moderately Congested Intersections (LOS F or ICU > 100%)
HC Highly Congested Intersections (Delay > 110 seconds per vehicle <u>and</u> ICU > 110%)

Exhibit 4-22. Existing (2002) PM Peak Hour Detailed Traffic Operations, North Waterfront

Street	Cross Street	Identified as Congested	LOS	Avg Veh Delay	ICU
Elliott Avenue	Broad Street	-	C	28	68%
	Moderately Congested Intersections	0			
	Highly Congested Intersections	0			
	Total Congested Intersections	0			

MC Moderately Congested Intersections (LOS F or ICU > 100%)
HC Highly Congested Intersections (Delay > 110 seconds per vehicle and ICU > 110%)

Exhibit 4-23. Existing (2002) PM Peak Hour Detailed Traffic Operations, North

Street	Cross Street	Identified as Congested	LOS	Avg Veh Delay	ICU
Elliott Avenue	Denny Way (Western Avenue)	MC	F	100	105%
Broad Street	Denny Way	-	C	26	77%
First Avenue	Denny Way	-	B	17	95%
Second Avenue	Denny Way	MC	C	34	111%
Second Avenue	Battery Street	-	B	15	44%
Fifth Avenue	Roy Street	-	B	15	61%
Fifth Avenue	Mercer Street	-	C	30	60%
Fifth Avenue	Broad Street	-	C	32	57%
Fifth Avenue	Denny Way	-	B	14	58%
Dexter Avenue	Roy Street	-	A	7	51%
Dexter Avenue	Mercer Street	-	D	50	82%
Dexter Avenue	Harrison Street	-	A	7	37%
Dexter Avenue	Denny Way	MC	B	14	111%
Aurora NB	Denny Way	-	D	37	96%
Aurora SB	Denny Way	-	B	10	54%
	Moderately Congested Intersections	3			
	Highly Congested Intersections	0			
	Total Congested Intersections	3			

4.5 Transit Service

Downtown Seattle is served by a well-developed system of bus transit, supplemented by a large, regionally implemented vanpool program, a waterfront streetcar, the Monorail between Seattle Center and Westlake, and Sound Transit Commuter Rail connecting Tacoma, Kent, Tukwila, and Seattle.

Bus routes using SR 99 to access downtown are shown in Exhibit 4-24. Inbound express bus routes serving West Seattle and Burien use SR 99, entering or exiting downtown at the Seneca Street off-ramp or Columbia Street on-ramp. Because the first downtown stop for these routes is at First Avenue and Union Street, many riders who need to reach the southern portion of downtown must transfer to other services to backtrack southbound.

All bus transit serving northwest Seattle by way of SR 99 enters or exits the downtown at the Denny Way ramps. From there, a number of surface streets provide access into the downtown area.

4.5.1 Current Transit Services

Bus Service

As shown in Exhibit 4-25, several metro routes use SR 99/Alaskan Way Viaduct during the peak hours. The ramps that are used are the northbound off-ramp at Seneca Street, the southbound on-ramp at Columbia Street, and the ramps at Denny Way.

In addition, an extensive network of bus routes converges on downtown Seattle from I-5 and via surface streets. Exhibit 4-24 depicts the routes used by transit services in the downtown area. In general, bus routes are oriented north–south, utilizing First Avenue, Second Avenue, Third Avenue, Fourth Avenue, and to a lesser extent, Fifth Avenue. In addition, a number of express routes from Seattle neighborhoods and neighboring communities use the Metro Bus Tunnel in downtown, which runs beneath Third Avenue and Pine Street. Bus routes in the tunnel may be accessed via the International District Station (S. Jackson Street at Fifth Avenue), Pioneer Square Station (Third Avenue at Cherry Street), University Street Station (Third Avenue at University Street), Westlake Center (Pine Street at Fifth Avenue), or Convention Place Station (Pine Street at Fifth Avenue).

Most transit service operating on east–west streets in the downtown area (including James Street, S. Jackson Street, Yesler Way, Marion Street, Madison Street, Spring Street, Seneca Street, Pike Street, and Pine Street) is oriented to provide service between downtown and the Capitol Hill/First Hill neighborhoods or uses those streets for short segments only as part of a larger north–south oriented route.

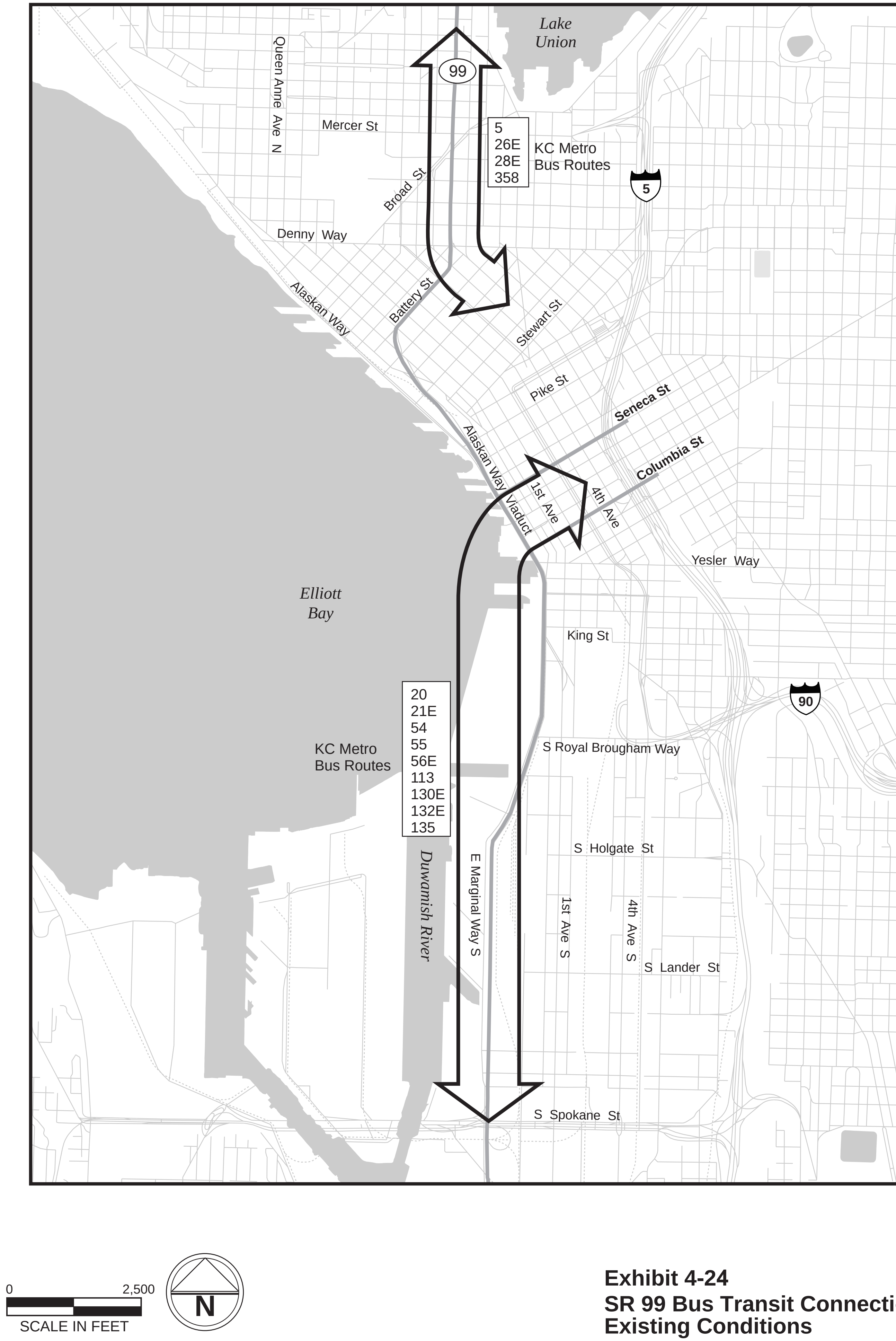


Exhibit 4-24
SR 99 Bus Transit Connections - Existing Conditions

Exhibit 4-25. Existing Transit Routes Using SR 99/Alaskan Way Viaduct

Route No.	Description	Ramp Usage	Buses Per Hour AM Peak	Buses Per Hour PM Peak
5	To Seattle	Denny Way	6	5
	To Shoreline	Denny Way	5	4
5E	To Seattle	Denny Way	4	
	To Shoreline	Denny Way		3
20	To Seattle	Seneca Street	5	2
	To White Center	Columbia Street	2	5
21E	To Seattle	Seneca Street	4	
	To Arbor Heights	Columbia Street		4
26E	To Seattle	Denny Way	4	
	To Greenlake	Denny Way		3
28E	To Seattle	Denny Way	4	
	To Broadview	Denny Way		4
54	To Seattle	Seneca Street	3	3
	To White Center	Columbia Street	2	3
54E	To Seattle	Seneca Street	3	
	To White Center	Columbia Street		3
55	To Seattle	Seneca Street	4	2
	To Admiral District	Columbia Street	2	4
56E	To Seattle	Seneca Street	2	
	To Alki	Columbia Street		2
113	To Seattle	Seneca Street	2	1
	To Shorewood	Columbia Street	2	2
130E	To Seattle	Seneca Street	3	
	To Des Moines	Columbia Street		2
132E	To Seattle	Seneca Street	3	
	To Des Moines	Columbia Street		2
135	To Seattle	Seneca Street	3	2
	To Burien	Columbia Street	2	4
358	To Seattle	Denny Way	9	5
	To Aurora Village	Denny Way	4	10

Other agencies providing bus service within the study corridor are Sound Transit, Community Transit, and Pierce Transit. These transit agencies are primarily commuter services in that they provide express service to downtown Seattle from outlying cities and neighboring counties. Sound Transit provides service to cities throughout the region in Snohomish, King, and Pierce Counties. Community Transit provides commuter service to downtown Seattle from Snohomish County, and Pierce Transit provides commuter service to downtown Seattle from Pierce County. These transit providers operate routes that access downtown on I-5 or I-90. Other than King County Metro, none of the region's transit agencies use SR 99 within the study area.

Vanpools

The transit agencies in the region all operate vanpool programs, with Metro's being the nation's largest public vanpool program. Under Metro's program, the transit agency provides and maintains a vehicle, provides ride-matching service and support, and in turn collects a fee from vanpool users to cover expenses. Currently, 45 of Metro's active vanpools serve destinations in downtown Seattle. Vanpools are dependent on the regional highway system, including HOV facilities where available, as well as local streets for mobility.

Waterfront Streetcar

The Waterfront Streetcar runs from Jackson Street and Fifth Avenue to Main Street and toward the waterfront and north on Alaskan Way to the Broad Street intersection. There are a total of nine stops. The streetcars run approximately every 20 minutes and 7 days a week.

The streetcar is popular with tourists and visitors, but also provides access to downtown activities and businesses located in the central waterfront area, International District, Pioneer Square, and Pike Place Market. It also interfaces with several other transportation modes, including the Metro Transit Tunnel at the International District Station and the Colman Dock Ferry Terminal. A number of Metro bus stops are located in close proximity to the streetcar stations, as are pedestrian facilities such as the Bell Street pedestrian overpass and the Marion Street pedestrian overpass. The current service function is to serve pedestrians to some of the cultural, recreational, and shopping attractions within the Seattle waterfront area.

Commuter Rail Service

Sound Transit's commuter rail line, Sounder, travels between Tacoma and the King Street Station in downtown Seattle and serves the communities of Puyallup, Sumner, Auburn, Kent, and Tukwila. Park-and-ride facilities in these communities further extend the effective reach of the service. In December 2003, additional service between Everett and Seattle was introduced.

Currently, Sounder operates three commuter trips between Tacoma and Seattle during the morning (into Seattle) and evening (out of Seattle) commute periods on weekdays. One train operates between Everett and Seattle each day as well, traveling to Seattle in the morning, and returning to Everett in the evening. Occasional weekend or extra trips for special events such as Mariners or Seahawks games also operate.

The King Street Station interfaces with several other forms of transportation, including the Waterfront Streetcar and Metro Transit Tunnel. The Weller Street pedestrian bridge provides a direct connection between Sounder service and the Metro Bus Tunnel.

4.5.2 Transit Measures of Effectiveness

MOE T1: Transit Connections

Currently, all transit service on SR 99 in the study area exits the corridor to access downtown Seattle. Transit using SR 99 from West Seattle or points south accesses the downtown area at the Seneca and Columbia Street ramps. These ramps provide fast service to the retail core, but passengers must transfer to other buses or walk to reach offices or other destinations in the southern portion of downtown.

There is no direct access to the Alaskan Way Viaduct to and from the north in downtown Seattle, so transit routes serving the north end access SR 99 from Denny Way, or north of Denny Way from Dexter Avenue N. or Fifth Avenue N.

MOE T2: Transit Travel Times and Coverage Area

All transit routes that utilize the SR 99 corridor access downtown at the Denny ramps to the north, or the Columbia and Seneca ramps downtown. Since HOV or transit-only facilities are not provided on the corridor, transit routes are subject to the overall operating conditions and performance of SR 99. MOE H2 reports travel times for general-purpose trips between downtown Seattle and S. Spokane Street, as well as for downtown Seattle and the Aurora Bridge. These two travel routes correspond to the transit services that use the SR 99 corridor and will provide a basis for comparing relative changes in travel times for 2030 build conditions.

As mentioned in the previous section, transit services utilizing the downtown have direct access into the area at Seneca and Columbia Streets, but are not able to effectively provide access to the southern portions of downtown or the Pioneer Square and Stadium areas.

4.6 Freight Movement and Demand

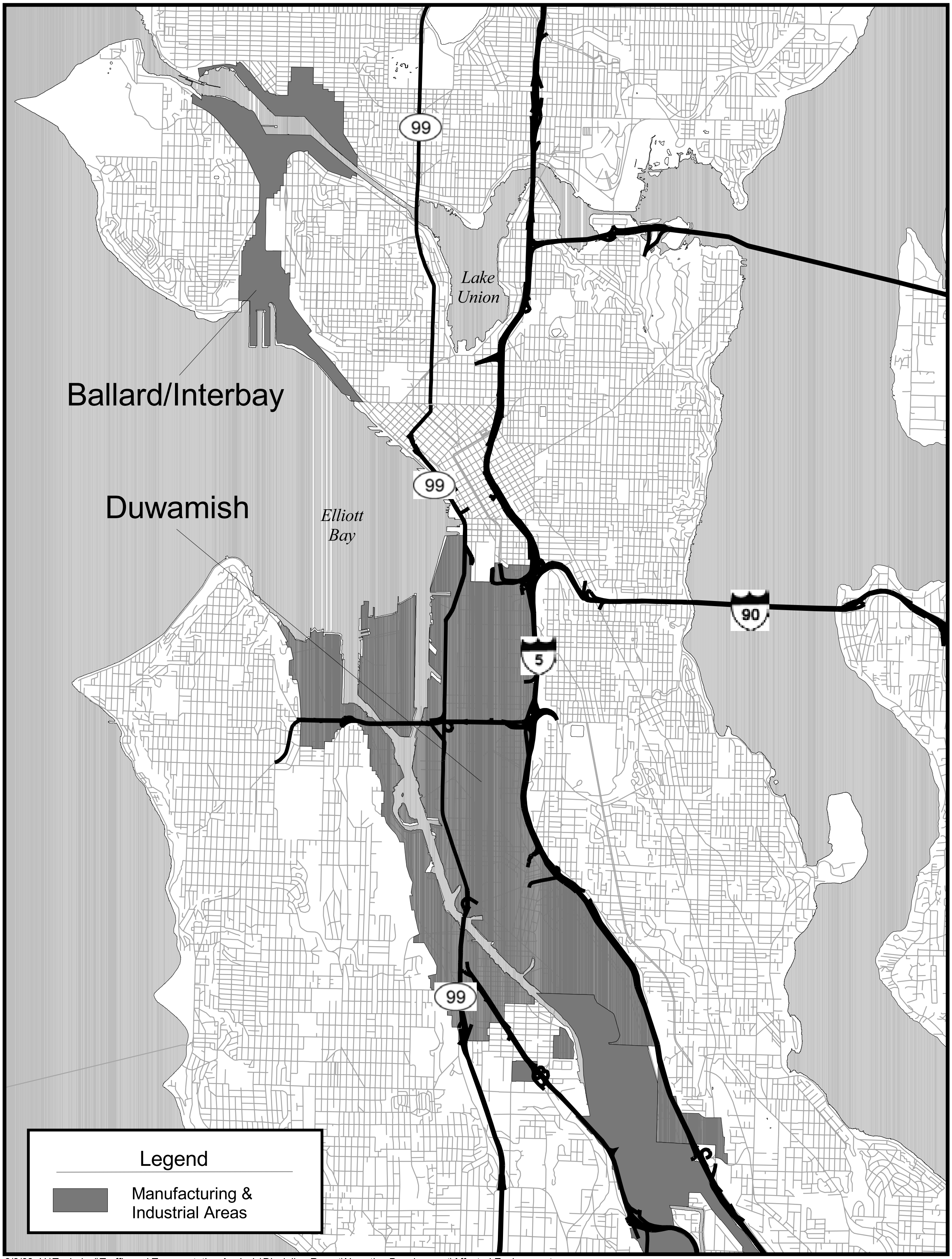
The AWV is a heavily used truck corridor and an important link for freight movement. It provides access for commercial businesses in the Duwamish and south downtown areas to northwest Seattle neighborhoods and is an important route for freight to and from the Ballard/Interbay manufacturing and industrial area. This section provides baseline information about the type and destination of truck trips generated in the SR 99 corridor, existing freight routes and their use, and freight access and operation conditions.

4.6.1 Freight Generators

The AWV Corridor serves areas that generate substantial freight and truck traffic. Most important are the Ballard/Interbay and Duwamish manufacturing and industrial areas, which also include Port of Seattle facilities and rail sorting, classification, storage, and switching yards for both the Burlington Northern Santa Fe (BNSF) and Union Pacific (UPRR) railroads. Exhibit 4-26 shows the boundaries of both manufacturing and industrial districts as determined by King County in cooperation with King County cities. Light industrial and warehouse uses north and south of downtown Seattle in the SODO and South Lake Union neighborhoods also generate substantial truck traffic. Historically, freight-related businesses have clustered north and south of downtown Seattle to be near to both marine and railroad access. City and county policies aim to protect manufacturing and industrial land uses from competing urban and waterfront activities.

Ballard Interbay Northend Manufacturing and Industrial Center

King County has designated the south end of Ballard and the Interbay area as a manufacturing and industrial center. The Ballard Interbay Northend Manufacturing and Industrial Center (BINMIC) comprises 843 acres, with over 1,000 businesses employing 14,200 employees. Many of these businesses are located in this area due to its marine access. Commercial fishing and marine-related businesses such as ship repair are located here. Aside from the commercial fishing fleet, two-thirds of these businesses were classified in 1994 as industrial uses, and one-third are classified as manufacturing uses. Eighty-five percent were small businesses employing 25 or fewer employees. Rail access is provided at the Burlington Northern Balmer Yard. The Port of Seattle also has facilities in the area at Terminals 86 and 91 and Fishermen's Terminal.



6/3/03 U:\Technical\Traffic and Transportation Analysis\Discipline Report\Narrative Development\Affected Environment

Source: Puget Sound Regional Council

0 2500 5000 7500
SCALE IN FEET

N

Exhibit 4-26
Ballard/Interbay and Duwamish Manufacturing and Industrial Areas

The BINMIC area is not served directly by the regional highway system. The primary access to regional freeways and industrial areas south of Seattle is via 15th Avenue W., connecting to SR 99 by way of the Elliott Avenue and Western Avenue ramps. Alternative routes include 15th Avenue W. or Nickerson Street and Westlake Avenue N. to N. Mercer Street and I-5; however, Mercer Street and I-5 provide a less direct and more congested route during most workdays. Freight generators in Ballard also use arterial east-west streets in Ballard and Fremont to access SR 99, including Leary Way and N. 39th Street (note that N. 39th Street is not designated as a major truck street by the City of Seattle).

Duwamish Industrial Area

The Duwamish Manufacturing and Industrial Center stretches over 4,974 acres from the area south of downtown Seattle following the Duwamish River to unincorporated King County south of the Seattle City Limits. It includes Boeing's Plant 2 and most of the Port of Seattle, as well as over 1,700 businesses just within the City of Seattle. In 2000, 67,919 employees worked in the Duwamish Manufacturing and Industrial Center, up from 57,349 only 5 years earlier.

Marine access to the Duwamish area is provided through the Port of Seattle and along the Duwamish Waterway. Railroad access is provided at the BNSF Seattle International Gateway (SIG) and UPRR Argo intermodal yards. Highway access is provided to I-5 in several locations, including at SR 519 from Fourth Avenue S., at S. Spokane Street from Sixth Avenue S. and the S. Spokane Street surface route, and at Industrial Way. Alternative access routes to I-5 south include SR 99 to SR 599, SR 99 to SR 509 to SR 518, and Airport Road S. Access to I-90 is provided from Fourth Avenue S. at SR 519 or from S. Spokane Street to I-5 to I-90.

Freight trips in the North Duwamish area, including port-related trips, must share the street system with other uses, including stadium event and ferry access traffic, both of which can overwhelm the street network at times, preempting other uses. Roads and rail lines intersect at many locations, and rail traffic preempts use of the roadway when train activity is present. Since trains are assembled at rail switching yards in the area, some of the train activity is switching movements that can block intersections for an extended time. This causes truckers to rely heavily on existing grade-separated facilities to avoid conflicts with rail or heavy traffic conflicts; these facilities include AWV, the S. Spokane Street viaduct, and overpasses on Airport Way, First Avenue S., and Fourth Avenue S. The SR 519 project has added a new grade separation at S. Atlantic Street to provide grade-separated access in the eastbound direction between First Avenue S. and Fourth Avenue S., I-90, and I-5.

Port of Seattle and Railroad Intermodal Yards

The Port of Seattle is one of the largest west coast cargo centers, serving as the entry and exit point for marine cargo to and from the Pacific Rim and Alaska. Exhibit 4-27 shows Port of Seattle facilities, including marine cargo terminals at Harbor Island and the SW Harbor (T-5 and T-18), along Alaskan Way in the SE Harbor (T-25, T-30, T-37, and T-46), and in the Interbay area north of the study area (T-86 and T-91). The BNSF and UPRR intermodal yards are also shown.

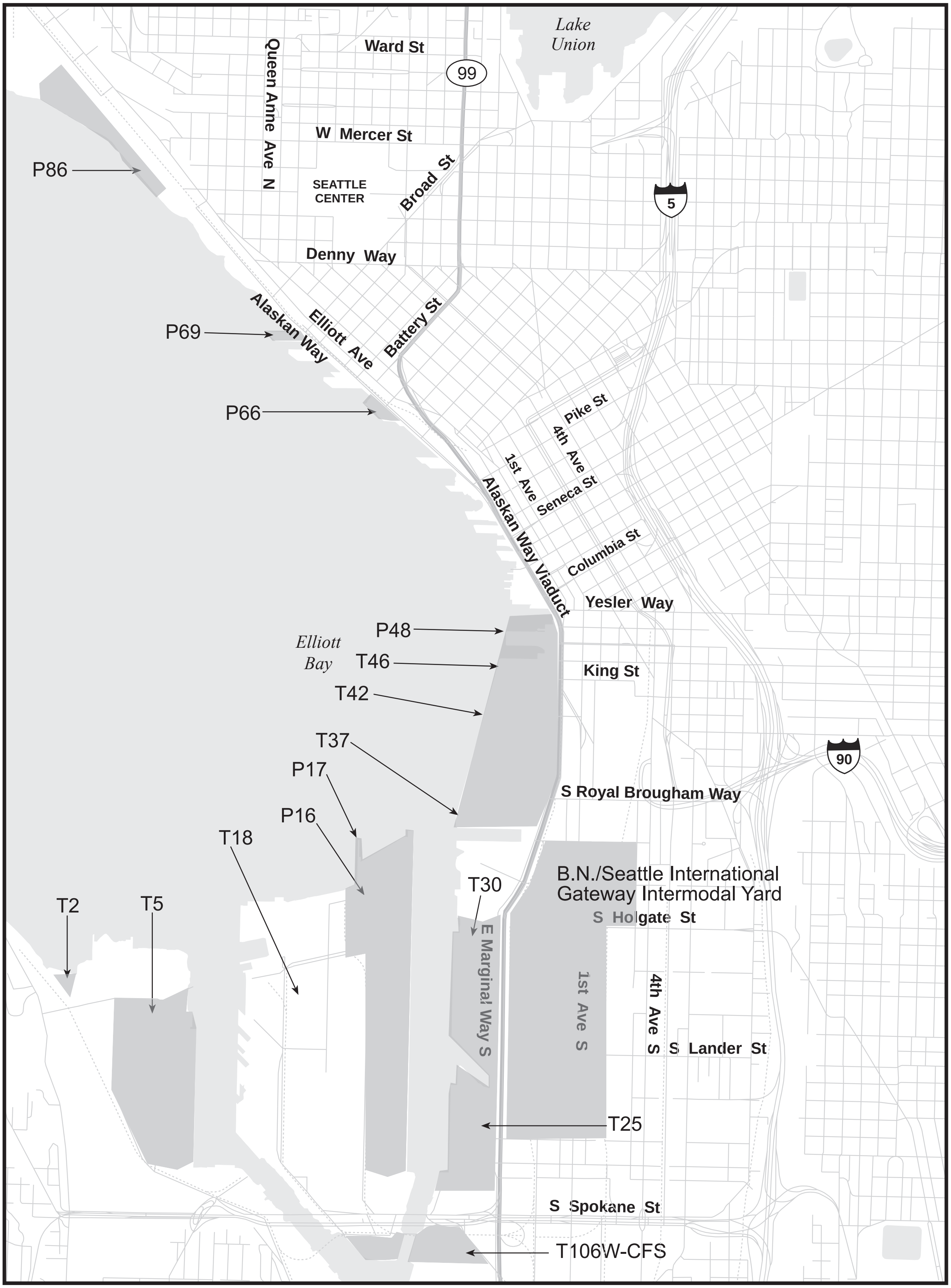
Most of the freight shipped through the port is in intermodal containers that are transferred to or from railcars or trucks on the dock. Terminals 5 and 18 have been upgraded over the past decade to include on-dock rail facilities. Some of the containers are shuttled (called "drayed") by truck to or from the BNSF or UPRR intermodal rail yards to be transferred to or from railcars remotely.

Trucks entering or leaving Terminals 5 and 18 use the S. Spokane Street viaduct to reach I-5, but use surface-level S. Spokane Street to get to and from Duwamish locations since there are no connections from the S. Spokane Street viaduct to the south on SR 99.

Terminals located along SE Harbor do not have on-dock rail facilities, and when ships are unloaded at these terminals, those containers bound inland by rail must be drayed between the terminal and the rail yard. The primary dray route is along E. Marginal Way to S. Atlantic Street, under the Alaskan Way Viaduct to the north entrance of the BNSF SIG Rail Yard. Other key truck arterials in the north Duwamish area include W. Marginal Way, Alaskan Way, and Michigan and Hanford Streets.

Bulk (non-containerized) grain shipments are made through Terminal 86, and generally these loads arrive and leave via rail rather than by truck. Bulk cargo also passes through Terminal 91, often as oversized vehicle loads that must use designated over-legal routes to reach their landside destinations. Alaskan Way surface street, Broad Street, and 15th Avenue W. are the designated over-legal route to and from the Interbay area.

Truck arrivals at port gates are constant between 8:00 AM and about 3:30 PM, with few arrivals during the noon hour when gate employees take lunch break. Port gate operation determines when trucks can arrive and leave, including the hours when the gates open and close and when employee breaks are observed.



PC-554-1585-025/06(0620) 12/03 (K)

SCALE IN FEET
0 2,500

N

Exhibit 4-27
Port of Seattle Facilities

Freeway access to and from I-5 and I-90 are provided at SR 519 and at S. Spokane Street from both the viaduct level and the surface roadway. Access to I-90 from S. Spokane Street requires entering and exiting from I-5 in a bottleneck location. Since I-5 is congested during much of the work day, alternate access to and from I-5 is provided using SR 509 and SR 518, SR 99 and SR 599, or via Airport Way S.

4.6.2 Freight Corridor Descriptions

Truck Route Designations

The state of Washington classifies freight routes according to the number of tons of cargo carried on them. Only state routes are classified this way. Truck freight tonnage on state routes is shown in Exhibit 4-28.

Exhibit 4-28. Freight Tonnage Designations for State Routes

State Route	Segment	Classification
5	Oregon border to Canadian border	T-1
5	Express Lanes	T-2
90	SR 519 to I-5	T-2
90	I-5 to Idaho border	T-1
99	South of Green Lake Way	T-1
99	North of Green Lake Way	T-2
99	Alaskan Way Viaduct	T-1
509	Sea-Tac to Seattle	T-2
599	I-5 to SR 99	T-1

Classification:
T-1 more than 10 million tons per year
T-2 4 million to 10 million tons per year
Source: WSDOT Freight and Goods Transportation System Update, 2001.

The City of Seattle designates all principal arterials as truck streets and has also classified certain streets as Major Truck Streets. By policy, the City will “monitor these streets and make operating, design, access and/or service changes, as well as capital investments, to accommodate trucks and to preserve and improve commercial transportation mobility and access on these major truck streets.” Seattle’s Major Truck Streets within the project study area are shown in Exhibit 4-29. SR 99 is designated as a major truck street, as are all or portions of 15th Avenue W., Elliott Avenue, Western Avenue, Broad Street, E. Marginal Way, First Avenue S., Fourth Avenue S., Sixth Avenue S., Airport Way S., S. Spokane Street, S. Lander Street, S. Royal Brougham Way, and Alaskan Way.

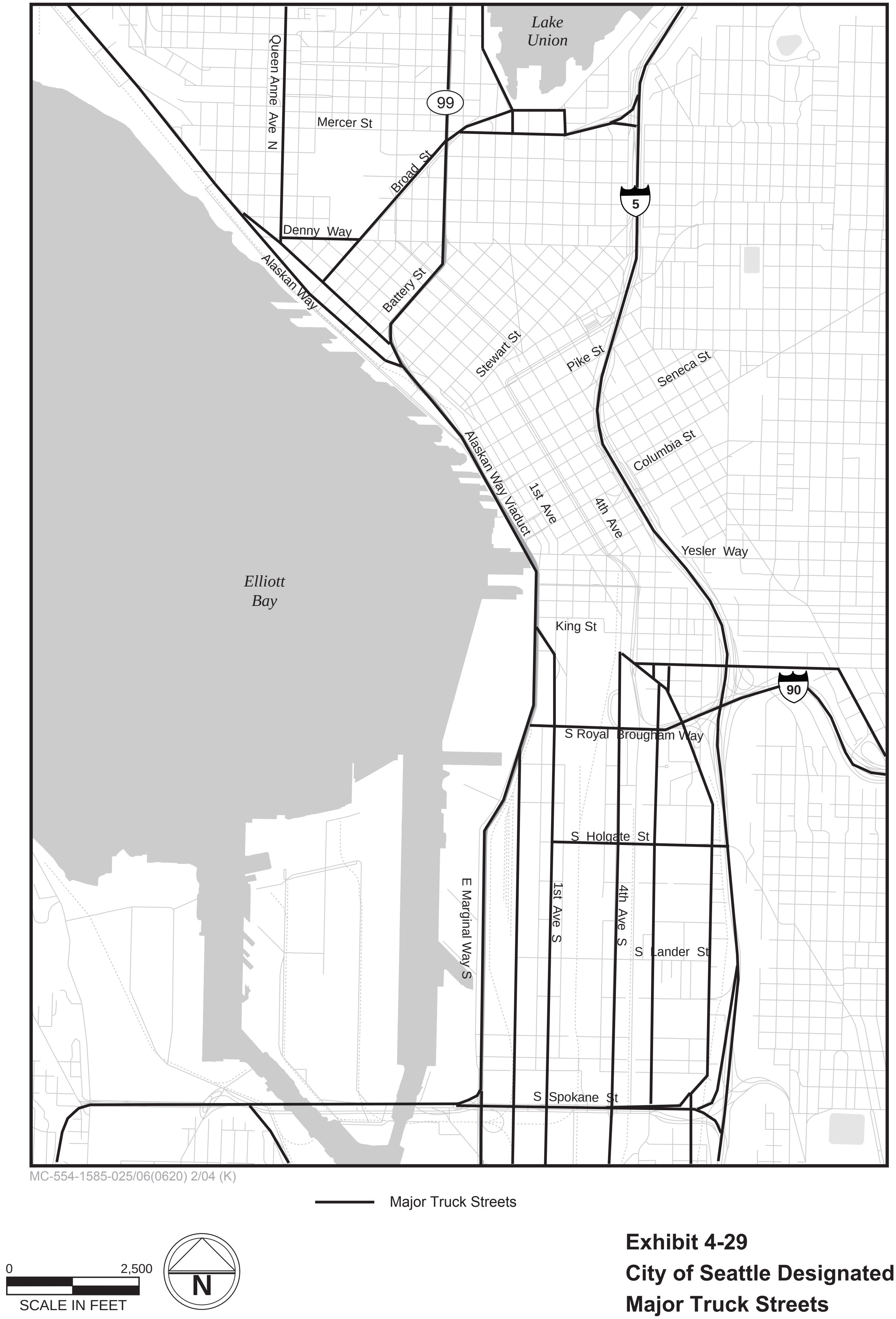


Exhibit 4-29
City of Seattle Designated
Major Truck Streets

Mainline Truck Volumes by Time of Day

Exhibits 4-30 and 4-31 show the volume of trucks (medium and large trucks, but not including small delivery vans the size of passenger vans) on the SR 99 mainline through downtown Seattle. The volume of trucks on the Alaskan Way Viaduct is small in comparison to the total volume of traffic traveling on the facility. During peak hours, total vehicular traffic on the viaduct can be close to 9,000 vehicles per hour. However, during the course of this study, the maximum truck traffic on the viaduct was measured to be about 300 trucks per hour. Approximately 5,200 trucks were counted traveling in both directions on the central portion of the AWV mainline in a 24-hour period during January 2002. Truck traffic on the viaduct tends to be greatest during the midday, unlike general traffic volumes that peak at 8:00 AM and 5:00 PM in both directions. Nighttime use of the viaduct by trucks is low.

Exhibit 4-32 provides further detail on traffic volumes by direction and truck type. By definition, medium trucks are larger than vans, but smaller than large transport trucks. During the hours of highest truck volumes on the viaduct, the number of medium trucks is double that of large transport trucks. On the viaduct, medium trucks are mostly delivery trucks and concrete trucks. Exhibit 4-32 further shows that northbound truck traffic tends to peak in the morning and southbound truck traffic tends to peak in the evening.

Exhibit 4-33 summarizes the daily distribution of trucks to and from SR 99 in the downtown area. On a daily basis, of the approximately 2,200 trucks traveling in the southbound direction through the downtown area on the Alaskan Way Viaduct, approximately 41 percent enter via the Battery Street Tunnel, 50 percent enter at the Elliott Avenue on-ramp, and 9 percent enter at the Columbia Street on-ramp. South of downtown, approximately 14 percent of the southbound trucks exit at the First Avenue S. ramp, and the remaining 86 percent travel through to West Seattle and points south. Truck volumes were surveyed after lane restrictions resulting from the February 2001 Nisqually earthquake were enacted. Trucks are restricted to the outside (right) lanes of the viaduct, which limits the use of the First Avenue S. ramps in particular.

Of the approximately 3,000 trucks traveling in the northbound direction through the downtown area on the Alaskan Way Viaduct, approximately 76 percent enter from West Seattle and points south on the mainline and 24 percent enter at the First Avenue S. on-ramp. Approximately 17 percent of northbound trucks exit at the Seneca Street off-ramp, 50 percent exit at the Western Avenue off-ramp, and the remaining 33 percent continue northbound through the Battery Street Tunnel.

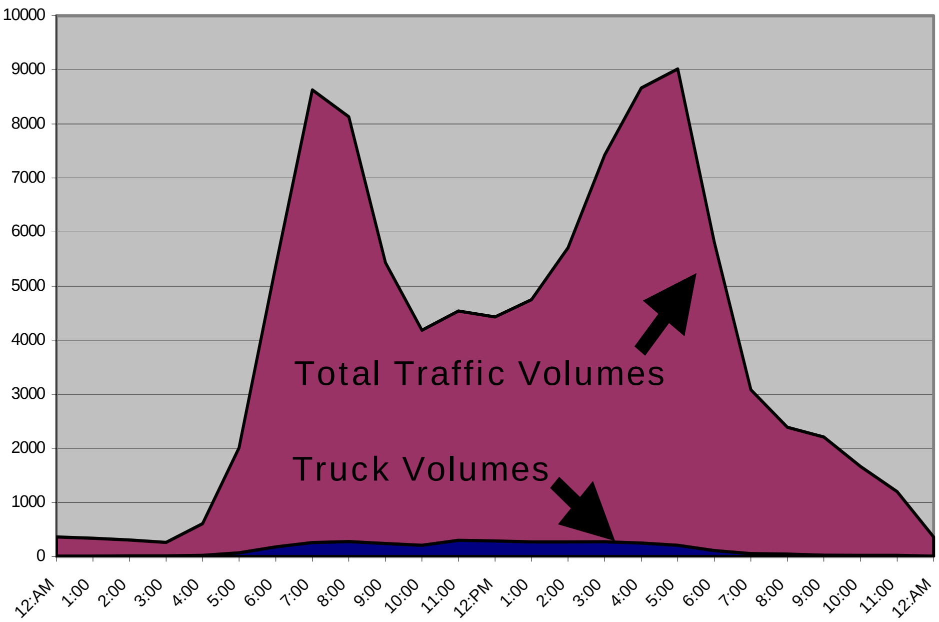
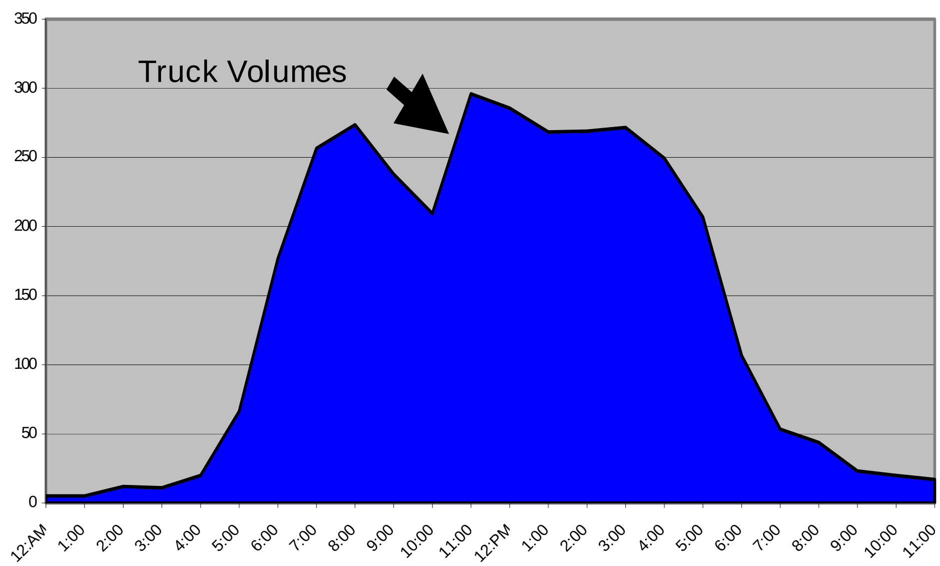
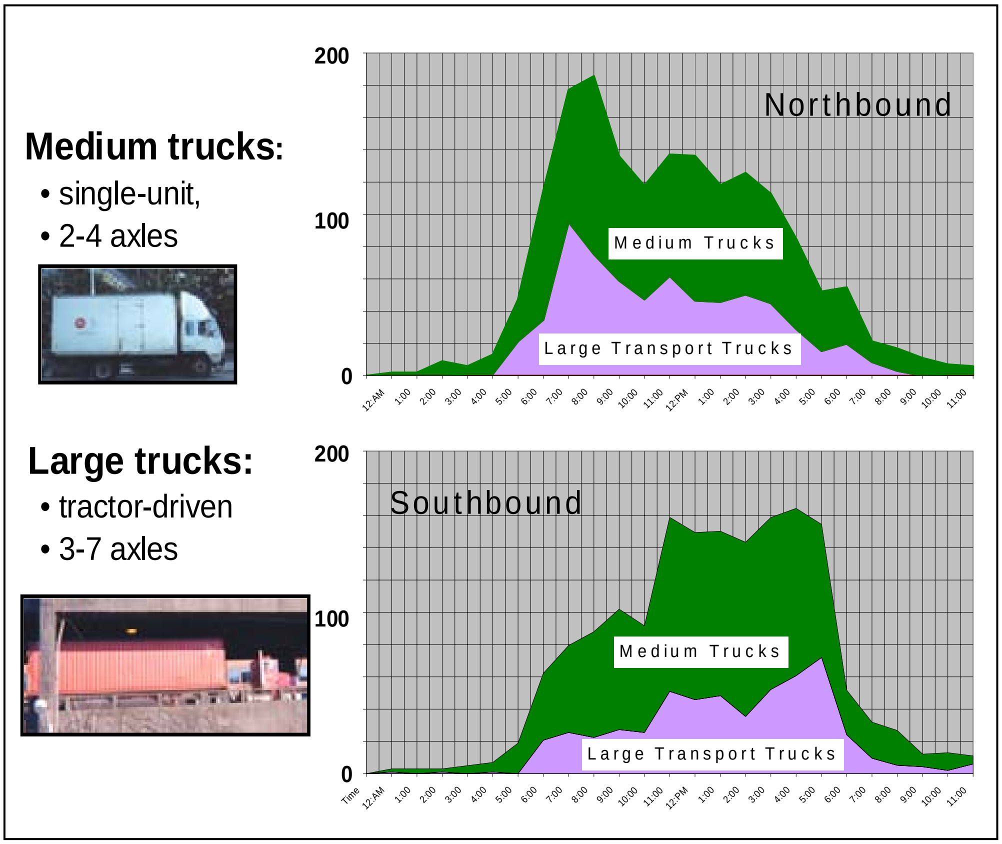


Exhibit 4-30. AWV Daily Distribution of Total Traffic and Truck Traffic (Midtown)



Source: Parsons Brinckerhoff Truck Use of the SR 99 Alaskan Way Viaduct

Exhibit 4-31. AWV Daily Distribution of Truck Traffic (Midtown)

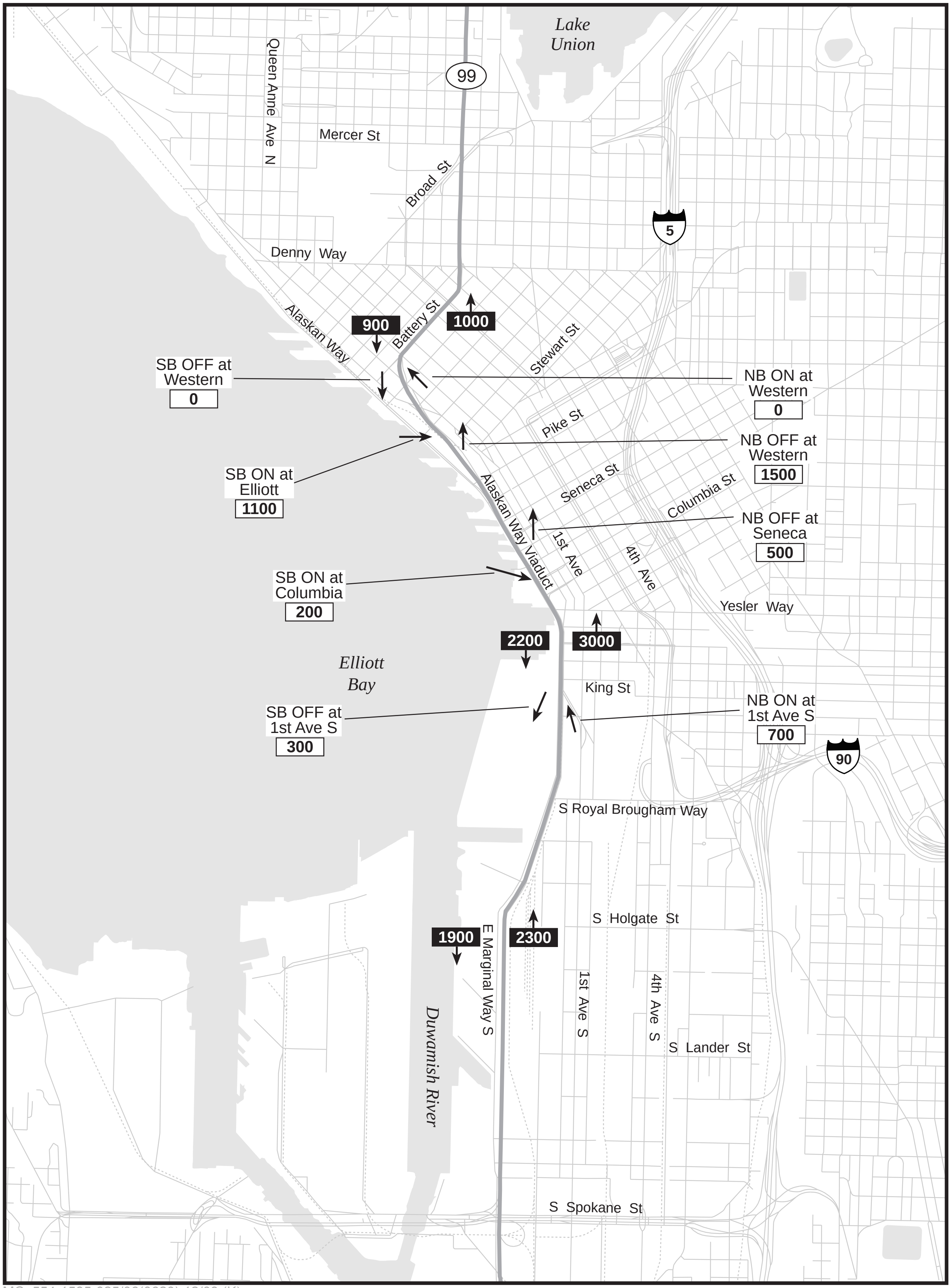


Source: Parsons Brinckerhoff

Exhibit 4-32. Distribution of Medium and Large Trucks by Direction (Midtown)

Truck Classification

Exhibit 4-34 presents 24-hour classification data for northbound and southbound trips through the Battery Street Tunnel and trips entering and exiting at the Western/Elliott ramps, taken from the August 2002 videotape at the south end of the Battery Street Tunnel. As expected, few of the trucks passing through the Battery Street Tunnel were large transport trucks. Truck traffic using the tunnel is expected to be primarily based south of downtown, making service trips to households and businesses in north Seattle. A greater proportion of trucks using the Elliott and Western Avenue ramps were large transport trucks, most likely based in the BINMIC area and accessing industrial areas or regional highways south of downtown Seattle.



MC: 554-1585-025/06(0620) 12/03 (K)

Exhibit 4-33
Existing (2002) Daily Truck Volumes on SR 99

Flammable Materials

Exhibit 4-34 shows the number of tankers observed during the August survey at the south end of the Battery Street Tunnel. Various sizes of tankers were noted; however, it was not possible to ascertain the types of loads they carried, nor whether they were flammable. Vehicles containing flammable materials are prohibited from the Battery Street Tunnel, and vehicles containing hazardous materials are prohibited from the Alaskan Way Viaduct in general during peak hours. The results show that tanker behavior is considerably different than other truck traffic, but that the volume of tanker traffic on the viaduct is less than hypothesized. Final counts revealed that 53 tankers used the viaduct on the day of the study. Overall, tankers compose only 2 percent of total daily truck traffic, making them negligible in total daily traffic volumes.

Exhibit 4-34. Classification of Trucks Observed on the AWV South of the Battery Street Tunnel

Truck Type	TOTAL		To/From Battery Street Tunnel		To/From Western/Elliott Corridor	
Liquid Transport/Tankers	66	(2%)	27	(2%)	39	(2%)
Medium Trucks (Single Units)	1626	(52%)	618	(50%)	1008	(54%)
Transport Trucks (Tractor Driven)	518	(17%)	290	(23%)	228	(12%)
Mega-Transport (Tractor, Two Trailers)	56	(2%)	32	(3%)	24	(1%)
Concrete & Construction Trucks	452	(14%)	128	(10%)	324	(17%)
Garbage Trucks	152	(5%)	29	(2%)	123	(7%)
Buses	196	(6%)	118	(9%)	78	(4%)
Total: All Trucks	3128	(100%)	1246	(100%)	1882	(100%)

Source: Parsons Brinckerhoff

Weight Restrictions

Following the Nisqually earthquake of February 2001, weight restrictions requiring truck traffic to use only the outside lanes of the SR 99 corridor were established. These restrictions limit the use of the southbound exit to First Avenue S., which is located on the left side of the roadway. Further deterioration of the viaduct structure could lead to further restrictions.

Alternative Truck Routes in the AWV Corridor

In case of congestion, incidents, or lack of access to the Alaskan Way Viaduct, different trucks have different alternative route options. Oversized or overweight trucks are limited to the designated over-legal route along Alaskan Way and Broad Street, or to I-5. Trucks larger than 27 feet are precluded from using city streets in the downtown area north of S. King Street from 6:00 AM to 6:00 PM daily, and therefore have the same options to use Alaskan Way and Broad Street or I-5 instead of the viaduct. Trucks 27 feet or smaller have the option to divert to city streets to get through the downtown area.

The Alaskan Way surface street has some drawbacks as a truck route. Truck traffic may be perceived to detract from increased waterfront and residential uses, including condominiums and sightseeing, and these uses reduce speeds and reliability for trucks along this route. Note that this is an issue along Elliott Avenue and Western Avenue through Belltown on the existing primary truck route from SR 99 also.

I-5 also presents challenges to truckers passing through downtown Seattle. Heavy congestion persists for much of the day. Frequent on- and off-ramps and heavy entering and exiting volumes make truck travel particularly difficult and require trucks to change lanes frequently to make a through movement. The Port of Seattle has identified access to and from the north on I-5 as an important issue resulting from congestion and poor operations on I-5 through downtown Seattle.

Freight Rail Corridors

BNSF maintains two mainline tracks through the study area, paralleling I-5 to the south and running between First and Fourth Avenues S., crossing S. Spokane Street, Lander Street, S. Holgate Street, and S. Royal Brougham Way (SR 519) at-grade. North of S. Royal Brougham Way is the King Street Station and a tunnel under the downtown area that emerges north of the Pike Place Market and follows the waterfront to points north. This route serves the Interbay switching and engine maintenance and refueling yard. The BNSF mainline serves the I-5 corridor south to Long Beach and north to British Columbia, connecting to east–west tracks crossing the Cascades at Everett, Auburn, and along the Columbia River. BNSF has agreements with the state, Amtrak, and Sound Transit to carry intercity and regional commuter rail passenger trips that are accessed at King Street Station. Passenger train switching and staging occurs on switching tracks north and south of SR 519.

UPRR maintains a single mainline track heading south from Seattle, using a shared alignment with the BNSF until Tukwila. The UPRR also serves the I-5 corridor and connects to east–west tracks at the Columbia River. The UPRR Argo intermodal switching yard is south of S. Spokane Street. Capacity of the combined UPRR and BNSF tracks is reduced due to operational conflicts caused by the need for UPRR trains to cross the BNSF mainline to access the Argo yard. Both the UPRR and BNSF tracks serving Terminals 5 and 18 cross E. Marginal Way at-grade, creating delays for heavy truck traffic in that area.

SIG and Whatcom Rail Yard Operations

The BNSF Seattle International Gateway (SIG) Rail Yard is located on the east side of SR 99, south of S. Atlantic Street. This intermodal yard is used to load cargo containers (most of which arrive by sea at the port facilities on the west side of SR 99) onto railcars, and switch railcars to build freight trains. A switching track, termed the tail track, extends north from the SIG Rail Yard, crossing S. Atlantic Street and S. Royal Brougham Way. Switching operations at the SIG Rail Yard frequently block these streets near their intersections with Alaskan Way. As part of the SR 519 Phase 1 project, the BNSF tail track will be relocated to the east side of Alaskan Way, eliminating blockage of S. Royal Brougham Way and S. Atlantic Street, but introducing crossings at E. Marginal Way (the southern continuation of Alaskan Way) and at the entrances to the T46 container terminal.

Two additional BNSF tracks pass through the Whatcom Rail Yard on the west side of SR 99. One track used for train assembly continues from the BNSF SIG Rail Yard north across S. Royal Brougham Way just west of the AWV structure, causing backups for trucks accessing Port terminals along the waterfront.

4.6.3 Freight Measures of Effectiveness

MOE FT1: Freight Mobility and Operations

Freight mobility and operations related to the SR 99 corridor are evaluated in Chapter 5 under year 2030 conditions for the existing facility and Build Alternatives by qualitative assessments of a number of factors:

- Qualitative assessment of the ability of the design to provide or improve upon existing truck connections. This includes access to port facilities, Harbor Island, and the Ballard/Interbay area. It also includes the ability to cross the corridor at SR 519 to reach I-90 and I-5.
- Assessment of travel time impacts (MOE H2) on major corridor truck/freight routes.
- Qualitative assessment of ability of design to facilitate truck operations (i.e., provision of appropriate turning radii, grades, etc.).
- Qualitative assessment of effect of alternative on freight train operations or facilities.

Existing (2002) information relevant to each of these is included below.

Truck Connections

This section addresses the basic ability of trucks to access the locations they need to get to and from. Access to the regional freeway system is key, as well as access to alternative routes in cases when the freeways are congested, and local access within the study area that could be affected by changes to the Alaskan Way Viaduct.

Ballard/Interbay Freeway Access

The BINMIC area is served by marine, rail, and truck transportation. In general, rail is competitive for longer trips greater than 500 miles, while local and regional freight trips are likely to be served by truck. Rail access is provided by the BNSF mainline, which runs along Alaskan Way and crosses Broad Street.

An important truck route serving the BINMIC area is provided by the SR 99 corridor and local connections via the Elliott Avenue/Western Avenue couplet and 15th Avenue W. This route provides a direct, quick corridor through the downtown area, but also travels through existing dense, urban residential and commercial areas in the Belltown neighborhood.

Alternative routes include Nickerson and Westlake, connecting to I-5 using Mercer Street, Leary Way and N. 39th Street connecting to SR 99 in Fremont, or 45th Street/50th Street connecting to I-5 north of the Ship Canal Bridge. Note that N. 39th Street is not designated by the City of Seattle as a major truck route.

While the BINMIC area does not have an immediate, direct connection to the regional freeway system, the SR 99 route via 15th Avenue W. and the Elliott/Western couplet are relatively reliable compared to I-5, and the viaduct provides good connections to the Duwamish area as well as SR 99, SR 599, and SR 518 connecting to I-5.

Access to I-5 and I-90 is possible using the First Avenue S. exit and using surface streets to connect to SR 519 at S. Atlantic Street. Access from I-5 and I-90 is more convoluted but still possible. Trucks must exit I-5 or I-90 onto Fourth Avenue S. and either turn right at S. Royal Brougham Way or use ramps to S. Atlantic Street in order to reach First Avenue S., where they turn right again to access SR 99 at the First Avenue S. ramps. Using S. Royal Brougham Way, trucks face delays from the intersection with the BNSF mainline tracks. No access is provided to and from the west on S. Spokane Street to reach I-5.

As noted above, adjacent land uses on Elliott Avenue and Western Avenue include urban residential and commercial uses, which make these segments less suitable as truck routes. However, alternative truck routes on surface streets along Alaskan Way, Nickerson, Westlake, and Mercer Streets run through areas of similar urban residential and commercial character, or additionally where general traffic conflicts reduce truck reliability.

An alternative route for over-legal loads is provided on Broad Street and along Alaskan Way surface street. A steep grade on Broad Street and an at-grade crossing with the BNSF mainline present obstacles to truck use of Alaskan Way surface street.

Duwamish/Harbor Island Freeway Access

Access to SR 99 from the Duwamish and Harbor Island industrial areas is provided by connections at Spokane Street (eastbound from Harbor Island to northbound SR 99, and from southbound SR 99 westbound to Harbor Island only), as well as from First Avenue north of the stadium area (to northbound and from southbound SR 99 only). Access at First Avenue S. is further limited by weight restrictions on the viaduct structure, which limits the ability for trucks to legally exit in the southbound direction.

Access to I-5 is provided at several locations in the Duwamish area, and several alternative routes exist, including SR 599 and SR 509. From Harbor Island, access to I-5 is provided directly using the S. Spokane Street viaduct. Access to other Duwamish destinations and alternative routes to avoid I-5 congestion is more difficult because there is no connection from the S. Spokane Street viaduct and SR 99 to and from the south. Instead, trucks must use the surface S. Spokane Street route and city streets, facing conflicts with at-grade rail crossings. Access to I-90 is direct from Fourth Avenue S., but somewhat convoluted from points west, as described in the previous section.

Travel Times Along Major Corridor Truck/Freight Routes

Travel times for trucks are similar to those for general traffic (as reported for MOE H2). Exceptions occur when trucks are restricted from using general-purpose facilities or when operation issues have a greater impact on trucks than on general traffic.

The two primary truck routes served by the corridor correspond to the following travel time routes reported previously for MOE H2. From Exhibit 4-12, these are:

- Aurora Bridge - Spokane Street: This route illustrates the travel time experience for vehicles traveling through the corridor, such as those freight trips from Harbor Island or points south of Seattle to locations served by the SR 99 corridor north of the Battery Street Tunnel.

- Ballard Bridge - SR 519 (Stadium Area): This route corresponds to the primary freight route between the BINMIC and Duwamish industrial areas.

As reported previously in Exhibit 4-12, general vehicle travel times for these routes are 8 minutes southbound/9 minutes northbound for the Aurora Bridge - Spokane Street route, and 12 minutes southbound/16 minutes northbound for the Ballard Bridge - SR 519 route. The later route can be problematic for northbound trucks at the Elliott Avenue off-ramp, where congestion can lead to frequent stopping and starting.

For an individual trucker, the time to access a specific port gate or intermodal terminal may be affected by the operation of the gate or terminal, and those issues are not addressed here.

Ability of Design to Facilitate Truck Operations

The AWV has narrow 10-foot lanes, very limited shoulders or shy distance to the edge of the roadway, limited sight distance entering and exiting the Battery Street Tunnel, lack of adequate acceleration and merging distances (particularly on the ramps at Seneca Street, Columbia Street, and the Battery Street ramps), and lack of refuge in case of breakdowns. These features reduce the AWV's ability to effectively and safely accommodate truck traffic. Additionally, trucks carrying flammable materials are restricted from using the Battery Street Tunnel, while transport of hazardous materials is prohibited on the Viaduct structure during peak hours.

Freight Train Operations and Facilities

Federal law and regulation give freight trains precedence over traffic at rail/roadway intersections. In general, roadway traffic does not affect train traffic movements. However, the frequency of roadway crossings, traffic volumes on crossing roadways, and the type of crossing control and protection can have an impact on train speed limits and can have a practical impact on the ability to conduct switching operations, which affects the overall capacity of intermodal container throughput into and out of the port area.

Train speed limits are relatively slow in the downtown and Duwamish industrial areas, partially due to frequent at-grade crossings. In general, train movements are not currently limited by design or activity relating to SR 99 related roadways. Areas of potential train/vehicle conflict do exist on the SIG yard tail track, as well as along Alaskan Way between Wall Street and Broad Street.

4.7 Washington State Ferry Service

4.7.1 Ferry Services

Washington State Ferries provides ferry service between downtown Seattle and both Bainbridge and Bremerton. These communities would not otherwise have direct access to Seattle, as the only alternate routes are by highway through Tacoma, or by ferry to Edmonds.

Colman Dock, located on Pier 50 and 52 on Seattle's downtown waterfront, is the Seattle terminus for this service. Access to Colman Dock is provided from Alaskan Way at Yesler Way, and exits are provided to Alaskan Way at Yesler Way and Marion Street.

Vehicle and Passenger Ferries

Two Jumbo Mark II boats, each with a capacity of 218 vehicles and 2,000 passengers, operate on the Bainbridge Island service between 4:20 AM and 1:00 AM daily, with departures and arrivals approximately every 50 minutes. Service to Bremerton is provided via a Super Class ferry, which has a capacity of 160 vehicles and 1,200 passengers, or a 140-vehicle Issaquah Class ferry. It operates on approximately an 80-minute headway daily between 4:45 AM and 1:30 AM.

Passenger-Only Ferries

Passenger-only ferries connect Seattle and Vashon Island. Service is provided by Tyee Class passenger-only vessels, which have a capacity of 270 people. During peak periods, service departs from Pier 50 roughly every 90 minutes with a 25-minute sailing time. Until recently, passenger-only service had also been provided to Bremerton. Kitsap Transit has expressed some interest in reinstating passenger-only ferry service, but as of autumn 2003, walk-on passengers from Bremerton or Bainbridge use standard vehicle ferry services.

4.7.2 Vehicle Traffic and Terminal Operations

Vehicles enter Colman Dock from Alaskan Way northbound at Yesler Way, using a signalized left turn. Right turns into the terminal from southbound Alaskan Way are prohibited during peak periods except for registered carpools. Vehicles pass through a toll area that has four booths and capacity for 35 queued vehicles. They then proceed to holding lanes that can accommodate roughly 650 passenger vehicles. Queued vehicles are directed from there onto the ferries.

When vehicle arrivals exceed dock capacity, queuing occurs at the northbound Alaskan Way left turn lane to the ferry dock, causing congestion for the remaining single lane of northbound through traffic. Data shows this does not currently occur often.

There are two vehicle exits from Colman Dock. The first is to Alaskan Way at Yesler Way. This exit is two lanes, and forces all traffic to turn right to southbound Alaskan Way. Traffic destined for downtown or other locations to the north must turn around on Alaskan Way, or more commonly, circle back into town on S. Royal Brougham Way to Fourth Avenue. The second exit is located at the signalized intersection of Alaskan Way and Marion Street, which allows vehicles to travel north or south on Alaskan Way, as well as east on Marion Street.

Maximum hourly capacities under current service levels are shown in Exhibit 4-35. Arriving (exiting) traffic cannot exceed these levels, as the ferry capacity limits the amount of traffic that can arrive inbound at Colman Dock. Outbound (to Bainbridge/Bremerton) traffic can exceed the maximum ferry capacity, however, as landside vehicle arrivals can outpace ferry departure capacity.

For PM peak hour analysis, 360 vehicles were presumed to exit Colman Dock: 145 at Yesler Way, and 215 at Marion Street. These estimates are based on traffic counts conducted at Colman Dock exit points to Alaskan Way at Yesler Way and at Marion Street. An arrival rate of 1,000 vehicles was presumed for traffic arriving at Colman Dock, exceeding ferry capacity. This high arrival rate to Colman Dock reflects very busy conditions, where departing ferries would be filled to capacity, and queuing would form on the on-dock holding areas. Typical daily arrival rates to Colman Dock are much lower, on the order of 600 vehicles per hour during the PM peak. Analysis of the higher arrival rate allows identification of traffic operating conditions during peak levels of ferry demand.

Exhibit 4-35. Existing (2002) PM Peak Hour Ferry Vehicle Capacity at Colman Dock

Route	Vessels Serving Colman Dock per Hour	Vessel Vehicle Capacity	Hourly Capacity (Arrivals or Departures)
Seattle – Bremerton	1	160	160
Seattle – Bainbridge	2	218	436
Total			596

MOE FY1: Access to/from Colman Dock

Passenger Connections to the Seattle CBD

The majority of foot passengers arriving at or departing from Colman Dock use the larger vehicle ferries. Loading and unloading is at the upper level of Colman Dock, from which a direct walkway is provided that crosses above Alaskan Way and below the viaduct, connecting to the sidewalk on the south side of Marion Street at First Avenue. Passengers can also enter and exit at Alaskan Way, where they can catch a bus, or cross Alaskan Way to take a taxi or ride the Waterfront Streetcar, which has a station at Madison Street. Signalized crosswalks crossing Alaskan Way are located at Marion Street, Columbia Street, and Yesler Way. Conflicting traffic volumes are heavy on Alaskan Way while ferries are unloading, as traffic exits at Marion Street (to northbound and southbound Alaskan Way, as well as eastbound on Marion) and Yesler Way (to southbound Marion Street only). Additionally, pedestrians using the Marion Street pedestrian overpass can face conflicts from turning vehicles as they rejoin the street-level sidewalk system at the intersection of First Avenue and Marion Street. While the intersection is signalized, exiting ferry traffic that wishes to turn right onto southbound First Avenue will face conflicting pedestrians in the crosswalk.

Automobile Access and Egress

Intersection analysis on Alaskan Way at Yesler Way and at Marion Street (presented in Section 4.4.7) shows highly congested operations at Yesler Way (average PM peak hour LOS F) and moderately congested operations at Marion Street (average PM peak hour LOS D). Both intersections operate at more congested conditions than reported during the specific intervals when ferry unloading takes place, but the average LOS D rating at Marion Street indicates that traffic operations recover at that location during periods when unloading does not occur. Yesler Way, which accommodates access as well as egress, operates at an average LOS F for the PM peak hour and exhibits congested conditions throughout.

4.8 Pedestrians and Bicycles

The Seattle waterfront is both a destination and a travel corridor for pedestrians and bicyclists. The Alaskan Way Viaduct (SR 99) crosses over pedestrian and bicycle access routes to the city and waterfront area as well as affecting the pedestrian environment in general. The AWV study area includes several noteworthy pedestrian generators, including:

- Major employment centers
- Major tourist attractions

- Green space/recreational areas
- Colman Dock ferry terminal

Additionally, the City of Seattle has identified several bicycle pathways within the study area of the project. These routes include both local and regional pathways. The following provides a summary of existing pedestrian and bicycle conditions for the study area.

4.8.1 Pedestrians

Within the study area, there are several major pedestrian corridors and generators. The following section divides the study corridor into the following sub-areas:

- South sub-area
- Central sub-area
- North Waterfront sub-area
- North sub-area

South Sub-Area

Pedestrian activity in the South sub-area generally is not as high as other sub-areas in the AWV study area. However, intersections in this sub-area, particularly those on First Avenue shown in Exhibit 4-36, experience significant pedestrian volumes during events at either of the nearby event venues: Safeco Field (Major League Baseball) and Seahawks Stadium and Exhibition Center (National Football League, soccer, concerts, and exhibition events). During larger events, such as a Mariner's baseball game, thousands of pedestrians crowd the sidewalks and alleys in the Stadium area and to the north into Pioneer Square. During such events, traffic control is typically provided to accommodate the very high vehicle and pedestrian volumes.

PM peak hour pedestrian volumes representative of the sub-area during non-event times are shown in Exhibit 4-36. Both of the intersections shown in Exhibit 4-36 are signalized. Before and after events, these and other nearby intersections become saturated with pedestrian activity and traffic level of service becomes severely degraded.

Exhibit 4-36. Existing PM Peak Hour Estimated Pedestrian Counts for the South Sub-area (Non-Event)

Street	Cross-Street	North Leg	South Leg	East Leg	West Leg	Control
First Avenue	S. Royal Brougham Way	10	10	10	10	Signalized
First Avenue	S. Atlantic Street	32	8	42	11	Signalized

Central Sub-Area

The Central sub-area consists of the central waterfront area and the downtown area. Primary pedestrian traffic generators along the waterfront include tourist activities, businesses, recreational uses, and ferry service. Exhibit 4-37 presents PM peak hour pedestrian volumes at select intersections along the waterfront. As seen in Exhibit 4-37, the entrance to the Colman Dock ferry terminal located at the intersection of Alaskan Way and Marion Street generates a relatively high volume of pedestrians. Note that the data collected in Exhibit 4-37 was collected in winter and during the PM peak hour; pedestrian activity on the waterfront promenade is substantially higher in summer and on weekends.

Within the downtown area, pedestrian activity is generally associated with typical workday activities and schedules. Additionally, First Avenue, Second Avenue, and Third Avenue are major transit corridors, with frequent transit stops and associated pedestrian activities. Pedestrian volumes within the downtown area are shown in Exhibit 4-38. Significant volumes at the intersection of Marion Street and Second Avenue can be attributed in large part to the connection to the Marion Street over-crossing to the Colman Dock ferry terminal located at that intersection.

Exhibit 4-37. Existing (2002) PM Peak Hour Pedestrian Counts for Central Sub-area (Waterfront)

Street	Cross-Street	North Leg	South Leg	East Leg	West Leg	Control
Alaskan Way	Pike Street	60	40	55	80	Signalized
Alaskan Way	Pine Street	110	55	5	*	Unsignalized
Alaskan Way	Spring	59	72	46	300	Unsignalized
Alaskan Way	Madison Street	284	136	86	*	Signalized
Alaskan Way	Marion Street	5	120	95	180	Signalized
Alaskan Way	Marion St Ped Bridge	1790				Grade-separated
Alaskan Way	Columbia Street	25	50	135	45	Signalized
Alaskan Way	S. Jackson Street	45	100	20	10	Signalized
Alaskan Way	S. Main Street	40	15	65	90	Signalized

* Leg not counted

Exhibit 4-38. Existing (2002) PM Peak Hour Pedestrian Counts for Central Sub-area (Downtown)

Street	Cross-Street	North Leg	South Leg	East Leg	West Leg	Control
First Avenue	S. King Street	70	95	85	50	Signalized
First Avenue	S. Main Street	85	80	220	150	Signalized
First Avenue	S. Jackson Street	35	35	35	35	Signalized
First Avenue	Blanchard Street	135	170	85	95	Unsignalized
Western Avenue	Marion Street	70	75	120	55	Signalized
Western Avenue	Lenora Street	60	65	195	130	Signalized
Western Avenue	Blanchard Street	50	20	125	25	Unsignalized
Western Avenue	Bell Street	5	80	100	55	Unsignalized
Second Avenue	Marion Street	505	570	370	465	Signalized

North Waterfront Sub-Area

In the North Waterfront sub-area, the large number of visitors to the waterfront is augmented by activity related to the cruise ship industry. Overall, the Port of Seattle expects 400,000 cruise ship passengers to arrive at the waterfront in 2003. Bell Street Pier (Pier 66) includes a cruise ship terminal as well as the Bell Harbor International Conference Center, which hosts various conferences and other activities. Also, a significant number of residential units have been developed in recent years on the east side of Alaskan Way, generating additional pedestrian traffic on the waterfront.

The North Waterfront sub-area includes two major pedestrian facilities providing connections to the waterfront: the Bell Street footbridge, which extends over Alaskan Way and the BNSF railroad tracks and connects to the Bell Street Pier, and the Lenora Street footbridge, which provides access from Elliott Avenue to the east side of Alaskan Way.

Elliott Avenue and Western Avenue serve as the major north–south routes through the Belltown neighborhood for pedestrians. These two streets converge at the north end of the Pike Place Market. In this area, conflicts between pedestrians and vehicles using the AWV ramps at Elliott/Western are a concern. In particular, pedestrian crossings at the beginning of the southbound on-ramp at Elliott Avenue and at the end of the northbound off-ramp at Western Avenue often result in delays for vehicles using those ramps.

Exhibit 4-39 provides existing pedestrian counts for various intersections within the North Waterfront sub-area during the PM peak hour. Note that the volume shown for the north leg of the intersection of Alaskan Way and Bell Street are those on the pedestrian bridge that crosses over Alaskan Way.

Exhibit 4-39. Existing (2002) PM Peak Hour Pedestrian Counts for the North Waterfront Sub-area

<table>
<tr><th>Street</th><th>Cross-Street</th><th>North Leg</th><th>South Leg</th><th>East Leg</th><th>West Leg</th><th>Control</th></tr>
<tr><td>Alaskan Way</td><td>Clay Street</td><td>10</td><td>10</td><td>10</td><td>100</td><td>Signalized</td></tr>
<tr><td>Alaskan Way</td><td>Wall Street</td><td>40</td><td>40</td><td>40</td><td>115</td><td>Signalized</td></tr>
<tr><td>Alaskan Way</td><td>Bell Street</td><td colspan="2">25</td><td>35</td><td>165</td><td>Unsignalized</td></tr>
<tr><td>Alaskan Way</td><td>Bell St Ped Bridge</td><td colspan="2">145</td><td></td><td></td><td>Grade-separated</td></tr>
<tr><td>Elliott Avenue</td><td>Battery Street</td><td>25</td><td>15</td><td>35</td><td>360</td><td>Unsignalized</td></tr>
<tr><td>Elliott Avenue</td><td>Blanchard</td><td>10</td><td>5</td><td>50</td><td>125</td><td>Unsignalized</td></tr>
<tr><td>Elliott Avenue</td><td>Vine Street</td><td>30</td><td>25</td><td>15</td><td>325</td><td>Unsignalized</td></tr>
</table>

North Sub-Area

The North sub-area consists of the western portion of the South Lake Union neighborhood and the Seattle Center/Lower Queen Anne neighborhood. PM peak hour pedestrian volumes for the North sub-area are shown in Exhibit 4-40. The highest pedestrian activity of the intersections shown in the table can be seen on Denny Way and Dexter Avenue, which serve as the primary east-west and north-south pedestrian routes, respectively. As with the South Sub-area, pedestrian activity increases near the Seattle Center during events to levels considerably higher than during non-event times.

Exhibit 4-40. Existing (2002) PM Peak Hour Pedestrian Counts for the North Sub-area (Non Event)

Street	Cross-Street	North Leg	South Leg	East Leg	West Leg	Control
Thomas Street	Sixth Avenue	10	15	20	20	Unsignalized
Fifth Avenue	Roy Street	10	15	17	30	Signalized
Fifth Avenue	Broad Street	16	23	22	34	Signalized
Broad Street	Denny Way	40	27	31	49	Signalized
Dexter Avenue	Roy Street	6	14	20	31	Signalized
Dexter Avenue	Denny Way	47	40	54	14	Signalized
Dexter Avenue	Thomas Street	2	0	22	12	Unsignalized
Denny Way	NB SR 99	42	25	24	0	Signalized
Denny Way	SB SR 99	40	18	0	23	Signalized

4.8.2 Bicycles

Bicycles are used in the AWV study area both for recreational and commuting purposes. This section describes existing bicycle facilities and routes, planned facilities and routes, and how these facilities and routes relate to the existing SR 99 facility.

Bicycle Facilities and Designated Bike Routes

Seattle features an extensive network of bicycle facilities and routes. A substantial number of commuters travel to jobs in the downtown area via these routes. Exhibit 4-41 lists the designated bike lanes within the study area, and Exhibit 4-42 lists those roadway facilities within the study area commonly used by bicyclists. Major facilities include the multi-use path located to the east of the waterfront trolley, which runs the length of the waterfront area from the stadiums to Myrtle Edwards Park, and the multi-use trail that starts in Myrtle Edwards Park and runs northward through the Interbay area to Magnolia. Major bicycle routes in the study area include Second Avenue and Dexter Avenue, both of which feature bicycle lanes, and E. Marginal Way. Dexter Avenue serves as the main northbound and southbound route for bicyclists traveling downtown and points north. Second Avenue serves as the main route for bicyclists heading southbound through downtown, while First, Third, and Fourth Avenues are used for northbound travel. E. Marginal Way serves as the main route into and out of downtown for West Seattle residents.

City of Seattle designated bicycle facilities and routes in the downtown area are shown below in Exhibit 4-43.

Exhibit 4-41. Existing (2002) Bicycle Lanes in the Study Area

Arterial	From	To
Second Avenue	Denny Way	Yesler Way
Second Avenue Ext.	Yesler Way	S. Main Street
Dexter Avenue	Denny Way	Freemont Bridge/Nickerson
Pine Street	Minor Avenue	12th Avenue
S. Dearborn Street	Sixth Avenue S.	I-90 Trail

Source: City of Seattle Department of Transportation

Exhibit 4-42. Streets Commonly Used by Bicyclists

Arterial	From	To
First Avenue	Denny Way	Blanchard Street
First Avenue N.	Denny Way	Republican Street
First Avenue S.	Yesler Way	S. Spokane Street
First Avenue W.	Republican Street	W. Harrison Street

Exhibit 4-42. Streets Commonly Used by Bicyclists (continued)

Arterial	From	To
Second Avenue	S. Main Street	S. Jackson Street
Second Avenue N.	Thomas Street	Denny Way
Third Avenue W.	W. Olympic Place	Republican Street
Fourth Avenue	Yesler Way	Bell Street
Fourth Avenue S.	Yesler Way	S. Jackson Street
Sixth Avenue N.	Aloha Street	Boston Street
Sixth Avenue S.	S. Spokane Street	Airport Way
Seventh Avenue	Battery Street	Blanchard Street
Seventh Avenue S.	Airport Way	S. Dearborn Street
Eighth Avenue	Howell Street	Pike Street
Ninth Avenue	Howell Street	Pine Street
Airport Way S.	Diagonal Avenue	Sixth Avenue S.
Alaskan Way	Broad Street	E. Marginal Way S.
Bell Street	Seventh Avenue	First Avenue
Blanchard Street	Western Avenue	Seventh Avenue
Dexter Avenue	Denny Way	Battery Street
Eastlake Avenue	University Bridge	Howell Street
Harrison Street	Eastlake Avenue	Dexter Avenue
Howell Street	Eastlake Avenue	Eighth Avenue
Jackson Street	Alaskan Way	12th Avenue S.
Maynard Avenue S.	S. Dearborn Street	Airport Way
Mercer Street	Pontius Avenue	Eastlake Avenue
Pike Street	First Avenue	Eighth Avenue
Pine Street	Terry Avenue	Western Avenue
Pontius Avenue	Mercer Street	Harrison Street
Queen Anne Avenue	W. Harrison Street	Thomas Street
Republican Street	First Avenue W.	Third Avenue W.
Thomas Street	Queen Anne Avenue	Second Avenue N.
W. Harrison Street	First Avenue W.	Queen Anne Avenue
Ward Street	Eastlake Avenue	Lakeview Boulevard
Western Avenue	Blanchard Street	Yesler Way
Yesler Way	First Avenue S.	Alaskan Way

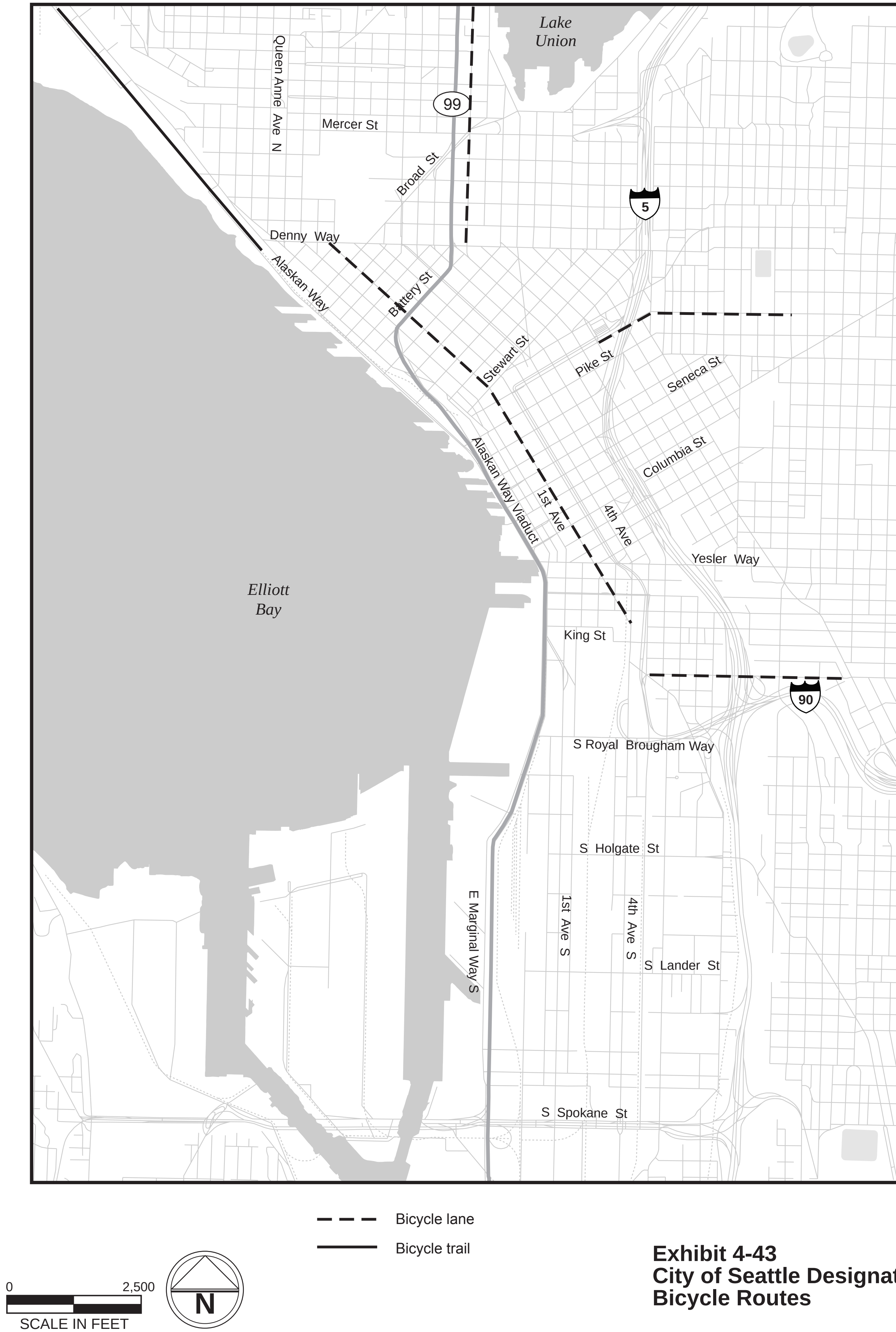


Exhibit 4-43
City of Seattle Designated Bicycle Routes

Existing bicycle counts were collected during the PM peak hour for several corridors. In the waterfront region, the AWV Corridor (including waterfront trail users) at Bell Street observed approximately 50 bicyclists per hour. Additionally, in the stadium region, the First Avenue corridor at S. Main Street counted approximately 15 bicyclists per hour. Finally, in the Belltown area, along Elliott Avenue at approximately Vine Street, five bicyclists per hour were observed.

Regional Connections

In the north end of the study area, the bicycle lane on Dexter Avenue connects to the Fremont Bridge and the Burke Gilman Trail, which provides regional connections to Ballard, the University District, and points beyond along Lake Washington. As mentioned previously, the trail in Myrtle Edwards Park leads to a trail through the Interbay area to Magnolia and a trail along the south side of the Fremont cut. To the south, E. Marginal Way connects to S. Spokane Street, along which bicyclists can travel to reach the low West Seattle bridge and a multi-use trail along the water around Alki Point. To the east, many bicyclists travel to downtown from Capitol Hill along Pike and Pine Streets. In the stadium area, S. Dearborn Street connects to the I-90 trail, which provides connections to Mercer Island and beyond.

Several planned bicycle improvements in the AWV study area include the Lake to Bay Trail (previously known as the Potlatch Trail). A City of Seattle project, this facility would provide access between the north waterfront area and South Lake Union via Broad Street and other streets near the Seattle Center. A proposed component of the project is an underpass under SR 99 at Roy Street, which would provide bicycle and pedestrian access across the highway. This project is not yet funded and is still in the planning stages. Other planned improvements include the following:

- A new bicycle/pedestrian overpass connecting lower Queen Anne to the waterfront is being built at Thomas Street (funded).
- The final link in the Mountains to Sound/I-90 Trail is currently under design and will terminate at the intersection of Alaskan Way and S. Atlantic Street.
- A new north–south trail will be built on the E-3 Busway in conjunction with the construction of Sound Transit's light rail system.

4.8.3 Nonmotorized Transportation Evaluation

MOE N1: Nonmotorized Opportunities and Impacts

Assessment of Pedestrian and Bicycle Facilities Along Alaskan Way

A widened sidewalk on the west side of Alaskan Way fronts waterfront businesses and attractions, acting as a pedestrian promenade. The promenade varies from 16 to 20 feet wide in the central waterfront area. In areas of high pedestrian use and activity such as the waterfront, a pedestrian space of 25 to 35 feet would generally be preferred to allow separation between those browsing street side activities and faster paced walkers.

The east side of Alaskan Way is only periodically fronted by sidewalks on the central waterfront, primarily at stops for the Waterfront Streetcar. Further north, sidewalk is provided between Pike Street and Clay Street. An asphalt walkway is provided for the length of Alaskan Way on the opposite (east) side of the trolley tracks. This path is used by a mix of users, including walkers and bicyclists, though it is not designed to Class I bikeway/multi-use path standards.

Pedestrians cross Alaskan Way both at-grade and at two pedestrian bridges. To the north, a pedestrian bridge connects to Elliott Avenue and Western Avenue at Bell Street. At Marion Street, a pedestrian bridge connects the ferry terminal to First Avenue, allowing commuters and other ferry users to access downtown without having to cross Alaskan Way at-grade. A third pedestrian bridge links the Belltown and north Pike Place Market area to Alaskan Way at Lenora Street (providing grade separation from SR 99 and the BNSF mainline), but does not cross Alaskan Way.

Surface crossings of Alaskan Way are provided regularly at intersections. The intersection at Yesler Way, Columbia Street, Marion Street, and Madison Street are signalized, allowing pedestrians to cross as Alaskan Way traffic is stopped (though pedestrians do have to contend with turning traffic from the side streets). Between Madison Street and Wall Street – a stretch of nearly one mile - signalized pedestrian crossings are provided only at University Street and Pike Street. Signalized crossing are provided at Wall and Clay Streets to the north.

Bicycle facilities are not presently provided on the corridor, though cyclists ride either in street or on the parallel asphalt path.

SR 99 Corridor Impacts to Nonmotorized Mobility

South of the Battery Street Tunnel, SR 99 is elevated as it passes over local streets and pedestrian facilities. Sidewalks on these local streets provide the majority of pedestrian routes between areas downtown and the waterfront.

Between University Street and Elliott Avenue, steep grades limit east–west connections under the AWV. The only pedestrian connection between downtown and the waterfront in this area is the Lenora Street pedestrian bridge. The viaduct structure itself is also a barrier to pedestrian travel to some degree. It is an imposing presence on the west edge of downtown, creating a visual barrier to the waterfront. Its shadows, dark spaces, and noise create an unfriendly pedestrian environment.

North of the Battery Street Tunnel, SR 99 divides the grid system and separates the South Lake Union area from Lower Queen Anne and the Seattle Center area. This segment of SR 99 is at-grade, and the only pedestrian crossings provided are at Denny Way, Mercer Street, and Broad Street.

Interaction Between Nonmotorized and Vehicle Traffic

Pedestrians and bicycles may encounter heavy traffic and fast-moving vehicles at locations where traffic enters or exits SR 99. The Denny Way ramps are one location where vehicles encounter pedestrians immediately as they exit the highway. These ramps have sidewalks and buses along their outside lanes. This has been identified by the WSDOT as a high pedestrian accident location, with four pedestrian accidents occurring between 1994 and 2000.

The Battery Street and Elliott Avenue/Western Avenue ramps also introduce highway traffic into a pedestrian environment with little transition. At the southbound on-ramp at Elliott Avenue and the northbound Battery Street on-ramp, accelerating traffic entering the highway crosses pedestrian traffic traveling along Western or Elliott Avenues. The northbound off-ramp to Western Avenue accommodates high traffic volumes, which encounter an active pedestrian environment immediately at the base of the ramp. An unsignalized crosswalk at Bell Street crosses the ramp immediately as it joins the street grid. Both Western and Elliott Avenue experience moderate to high levels of pedestrian activity.

At the southbound off-ramp to First Avenue S., pedestrians on First Avenue S. are routed around the ramp structure to a narrow, hidden walkway. The Columbia and Seneca Street ramps are signal controlled, and traffic is slowed to arterial speeds due to sharp curves on the ramps. Still traffic entering or existing the ramps encounters conflicting pedestrian traffic when turning onto or off of First Avenue to access the ramps.

4.9 Parking

Parking provided on the waterfront and proximate to SR 99 was assessed to gauge the amount and type of parking available in areas that could be affected by project alternatives.

4.9.1 Parking Impact Evaluation

MOE P1: Impact to Parking

Impacts to parking in the study area are assessed by describing the potential impact to the number of parking spaces by type (e.g., long-term, on-street) provided under each Build Alternative. In addition, the location and proximity to dependent uses is qualitatively discussed. The following sections describe existing parking conditions.

4.9.2 Parking Descriptions and Definitions

The following provides a brief description of the parking space definitions used, the classification and categories of the parking spaces, and a brief description of the four geographical sub-regions used within the parking study area.

Parking Space Definitions

The following definitions were used to define parking spaces and are summarized accordingly.

- Metered - metered parking spaces.
- Time Restrict - any public parking spaces that are time-restricted, but not metered. Includes 30 minute, 1 hour, 2 hour, passenger, and other loading zones.
- Bus/Taxi - parking spaces posted for taxis and buses; includes bus stops.
- Non-restricted - unmetered, unrestricted, on-street public parking.
- Government - posted Police spaces, Consul spaces, and other spaces designated for government operations.
- Pay Parking - parking spaces that require a permit, or are let to the general public for a fee.
- Tenant Only - off-street parking that is designated as restricted, or private, and is not let to the general public for a fee.

Parking Categories and Assumptions

Parking was grouped into four main categories, defined as the following:

- On-Street Parking - Short Term is the sum of (Metered) + (Time Restrict) spaces.
- On-Street Parking - Long Term is (Non-restricted) spaces.

- Off-Street Parking is the sum of (Pay Parking) + (Tenant Only) spaces.
- "Other" Parking is the sum of (Bus/Taxi) + (Government) spaces.

When the parking data were classified and categorized, there were some assumptions made in the analysis.

- Fire lanes (red curbed areas) are not included as a part of this study.
- Holding areas for the Washington State Ferries are not included in the existing or proposed parking space data.
- The SR 519 surface improvements were included as part of the baseline when determining existing parking availability and potential impacts.

Exhibit 4-44 summarizes the existing parking in the study area.

Exhibit 4-44. Summary of Existing Parking Within Study Area

	On-Street Parking			Off-Street Parking	Other Parking	Total
	Short Term	Long Term	Subtotal			
Stadium Region	93	261	354	477	0	831
Pioneer Square Region	155	15	170	18	0	188
Waterfront Region	388	0	388	229	34	651
North Waterfront Region	178	0	178	176	14	368
Total	814	276	1090	900	48	2038

Parking Study Geographical Regions

The parking study area included Marginal Way, Alaskan Way, the Alaskan Way Viaduct, associated ramps, and the frontage areas east of the viaduct structure from a southern terminus at S. Holgate Street to Broad Street in the north. The data collected for the area was sorted according to the four following geographic regions:

1. Stadium Region (from S. Holgate Street north to S. King Street)
2. Pioneer Square Region (from S. King Street north to Yesler Way)
3. Waterfront Region (from Yesler Way north to Pine Street)
4. North Waterfront Region (from Pine Street north to Broad Street)

In addition, the north (South Lake Union) area was evaluated only for potential parking impacts based on the various Alaskan Way Viaduct alternatives. Please refer to Section 5.8 for a description of the impact analysis conducted in the South Lake Union area.

4.9.3 Parking Under the Alaskan Way Viaduct

A total of 920 parking spaces are provided under the existing viaduct structure and on Railroad Avenue under the AWV ramps to and from First Avenue S. Three kinds of parking are located along the corridor: free public parking for use up to 24 hours, metered parking limited to 2 hours, and privately managed paid parking lots. Exhibit 4-45 shows the number of on-street and off-street parking spaces counted under the viaduct structure and on Railroad Avenue during spring of 2003. The data presented is a subset of parking values shown in Exhibit 4-44.

Exhibit 4-45. Parking Spaces Located Under the Alaskan Way Viaduct

Location	Free, 24-Hour Limit	Metered 2-Hour Limit	Privately Managed Paid Parking Spots	Other	Total
Under the viaduct on Alaskan Way	70	474	209	9	762
Under AWV ramps on Railroad Avenue	36	88	34	0	158
Total	106	562	243	9	920

Source: Parsons Brinckerhoff

North of S. King Street and on Railroad Avenue, most of the on-street parking supply under the viaduct is short-term metered parking serving waterfront visitors and access to nearby businesses. Space for deliveries is provided for businesses that load supplies from Western Avenue, and for taxicabs at the Colman Dock Ferry Terminal.

South of S. King Street, parking under the viaduct and along Alaskan Way is un-metered and available for use for up to 24 hours. These spots are used primarily for commuter parking and stadium events. Empirical observation suggests that waterfront workers who arrive early in the morning and leave in the mid-afternoon use many of these spaces.

City and regional policies discourage provision of long-term free parking in urban activity centers in order to encourage use of alternative transportation modes. Conversely, provision of sufficient short-term parking is considered vital, as businesses rely on short-term parking for their customers and suppliers.

The majority of metered spaces cost $1 per hour, and are limited to a 2-hour duration. On average, 68 percent of metered stalls were occupied on the weekday afternoon when the survey was conducted.

The PSRC 2002 Parking Inventory Report provides a breakdown of average parking cost and utilization rates by zone for the Seattle CBD area. Although the parking study area regions differ slightly from the PSRC zones as described in the 2002 Inventory Study, the PSRC zonal data does provide a close approximation to the parking utilization rate and costs associated with each region in the parking study area.

The north waterfront region has an approximate utilization rate of 63.5 percent with an average daily parking cost of $11.89. The waterfront region has an approximate parking utilization rate of 73.6 percent and a public parking daily rate of $15.12. The Pioneer Square region has an estimated 79.5 percent parking utilization rate with a public daily parking cost of averaging $10.60. The stadium region has a parking occupancy rate of 46.6 percent with a daily parking cost of $8.91.

4.10 Accidents and Safety

The Alaskan Way Viaduct was built over a 20-year period before 1960. The design standards over the years have changed to accommodate speeds and increased traffic. Accidents are a good indication of where there are design deficiencies. See Chapter 2, Methodology, for roadway facility descriptions. For this chapter, recent accident reports for the SR 99 study area between Spokane Street and the Broad Street interchanges were investigated. The study area falls into two jurisdictions, WSDOT and City of Seattle. WSDOT data was collected for the SR 99 mainline and ramps, while the data for surface street intersections were collected from the City of Seattle.

In general, the SR 99 accidents are mainly attributed to design deficiencies and congestion. Accidents can be reduced and safety improved by bringing the facility up to current design standards.

4.10.1 Summary of Accidents Types

WSDOT supplied an Accident History Report for the SR 99 corridor between milepost 28.85 (West Seattle Freeway interchange) and milepost 32.82 (Broad Street interchange). The accidents were collected from January 1999 through December 31, 2002. Exhibit 4-46 below summarizes the findings of the types of accidents.

Exhibit 4-46. Summary of AWV Accidents

	Fixed Object	Rear End	Enter at Angle	Side Swipe	Overturn	Other	Total	Injuries	Fatalities
Northbound Mainline	42%	29%	1%	16%	1%	11%	276	160	2
Northbound Ramps	20%	51%	5%	9%	3%	11%	74	43	0
Southbound Mainline	36%	32%	3%	20%	1%	8%	337	190	3
Southbound Ramps	21%	41%	5%	18%	3%	12%	66	36	0

Source: WSDOT

The majority of the accidents were either fixed objects or rear-ends. The mainline sections experienced mostly fixed object accidents, with 42 percent and 36 percent for the northbound and southbound lanes, respectively. The fixed object accidents can be attributed to the proximity of the bridge piers and barriers to the moving traffic. The following conditions contribute to the accident rates.

- Design speed ranges from 30 to 50 mph.
- Lane widths are less than 10 feet in places.
- No shoulders exist in many areas.

The primary accidents occurring on ramps were rear-ends, with 51 percent and 41 percent for the northbound and southbound ramps, respectively. Rear-end accidents are usually attributed to congestion and poor sight distance. In a closer look at the ramps, some of the common substandard design conditions are summarized below.

- Ramp grades exceed minimum design standards.
- Ramp connection to mainline and city streets is substandard in relation to speed, acceleration/decelerations lengths, tapers, horizontal curves, and sight distances.

The fatalities experienced were on the mainline and were 1 percent of the total accidents. The fatalities that occurred in the northbound direction were between Spokane Street and the First Avenue on-ramp and between the Western Avenue on-ramp and Denny Way in the Battery Street Tunnel. In the southbound direction, the fatalities occurred between Broad Street and Denny Way, Columbia Avenue on-ramp and First Avenue off-ramp, and First Avenue off-ramp and Spokane Street.

4.10.2 Accident Statistics

WSDOT supplied a list of where the High Accident Locations (HALs), High Accident Corridors (HACs), and Pedestrian Accident Locations (PALs) exist in the study area. HALs are defined by WSDOT as locations less than a mile long that have experienced a higher than average rate of severe accidents during the previous 2 years. A HAC is defined as a section of highway one or more miles long that has a higher than average number of severe accidents over a period of time. A PAL is defined as a section of state route with four or more pedestrian collisions with vehicles in a 6-year period. Exhibit 4-47 below summarizes the 2000 data for the study area.

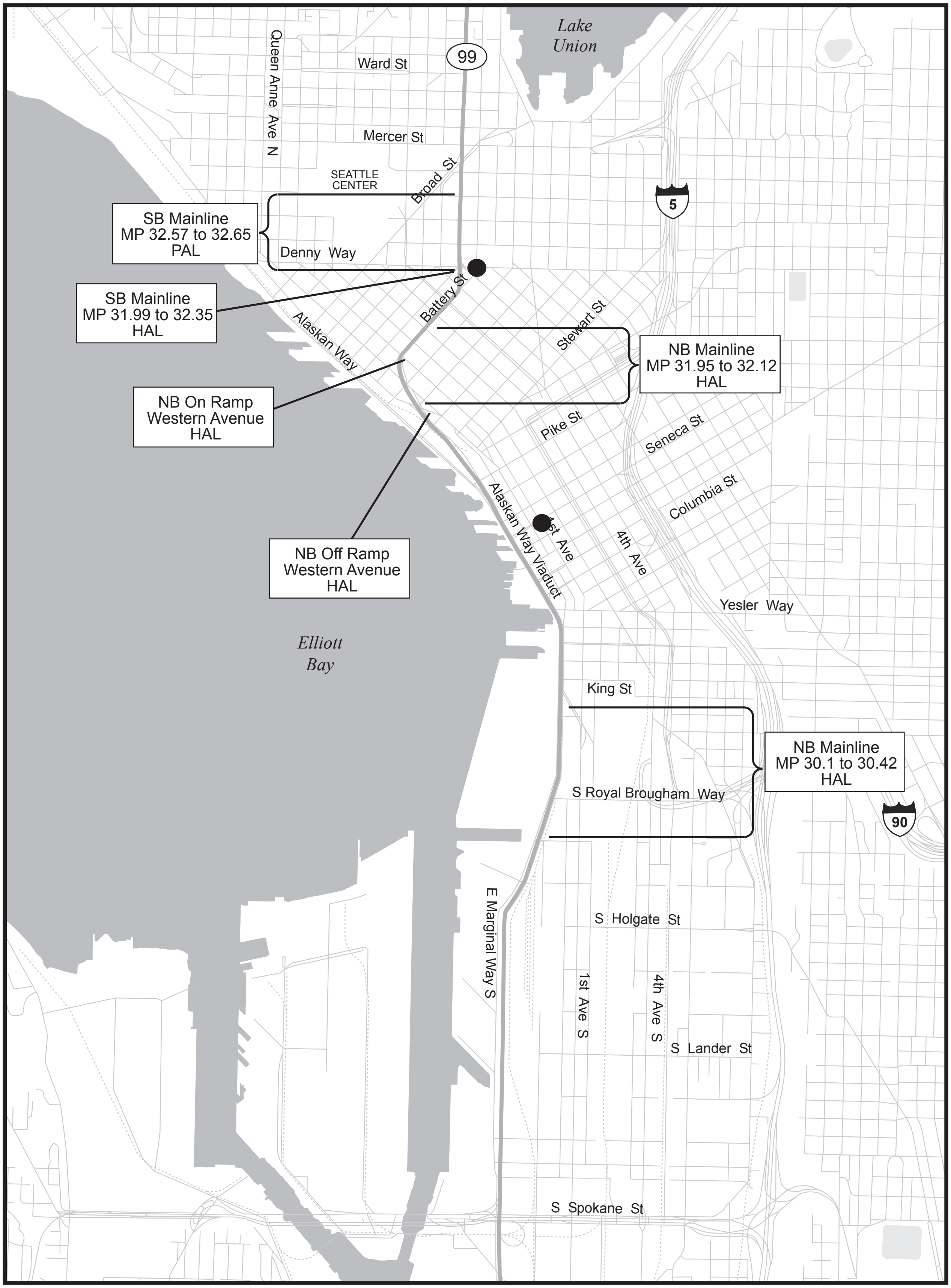
Exhibit 4-47. Summary of AWV High Accident and Pedestrian Accident Locations

Location	Beginning Milepost	Ending Milepost	Type of Accident
NB Mainline – South of First Avenue on-ramp	30.1	30.42	HAL
NB Mainline – Between Western Avenue and Battery Street Tunnel	31.95	32.12	HAL
NB off-ramp to Western Avenue	31.8	31.96	HAL
NB on-ramp from Western Avenue	31.94	32.03	HAL
SB Mainline – Battery Street Tunnel to Western Avenue off-ramp	31.99	32.35	HAL
SB Mainline – Harrison Street to Denny Way off-ramp	32.57	32.65	PAL

The summary shows that there are five HALs in the study area and one PAL. Exhibit 4-48 shows the location of HALs and the PAL on the facility. The northbound mainline viaduct to the south of First Avenue experienced one fatality accident and the majority of the accidents were either fixed object (38 percent) or rear-ends (34 percent). Several substandard designs as referenced from Appendix A of the "SR 99 Alaskan Way Viaduct Project: No Action (Existing Condition)" August 2002 Technical Memo may be attributed to this HAL. In the area of the HAL, both the inside and outside shoulders do not meet the standard criteria of 6 feet and 10 feet respectively; they are currently less than 1 foot. The vertical and horizontal stopping sight distances in this area are also substandard.

The other northbound mainline corridor with a HAL is between the Western Avenue on-ramp and the Battery Street Tunnel. This area also experienced one fatal accident. The majority of the accidents (68 percent) were fixed object accidents. The majority of the lanes in this area are narrower than the standard 12-foot lanes. The shoulder widths, as discussed above, are also substandard, as are the stopping sight distances. All of these factors affect the clearance to fixed objects in the area.

For the northbound off-ramp to Western Avenue, 77 percent of the accidents are rear-ends. The sight distance when exiting is limited by a vertical angle point, and when back-ups occur on Western Avenue, a vehicle cannot see the stopped vehicles in time to stop.For the northbound on-ramp from Western Avenue, again the rear-end accidents are a high percentage (80 percent) of the overall accidents. The accidents are due to the limited stopping sight distance for both the vertical and horizontal.



554-1585-025/06(0620) 2/04

0 2,500
SCALE IN FEET

N

● Intersections with 10 or more accidents

Exhibit 4-48
AWV High Accident Locations

The southbound mainline area between Battery Street Tunnel and the Western Avenue off-ramp has 60 percent of the accidents with fixed objects. This is due to the substandard lane widths, shoulder widths, and horizontal and vertical sight distances.

Pedestrian crossings are not permitted at-grade on SR 99, however a pedestrian accident location has been identified on southbound SR 99 north of the Battery Street tunnel. Pedestrian conflicts in this area could include pedestrians using side street crossings (which are allowed), or pedestrians crossing SR 99 despite the prohibition. Currently, no pedestrian crossings are provided between Denny Way and Mercer Street, so

4.10.3 Ramp Termini/Signalized Intersection Accident Analysis

The SR 99 roadway ramps terminate at either signalized intersections, such as at First Avenue S., or unsignalized intersections. The City of Seattle supplied High Accident Intersection data for 1998 through 2000, which is summarized below in Exhibit 4-49.

Exhibit 4-49. Intersection Accidents

	1998	1999
Signalized Intersections (10 or more accidents)		
First Avenue and Seneca Street	11	14
Denny Way and Dexter Avenue	21	11
Unsignalized Intersections (5 or more accidents)		
Bell Street and Western Avenue	5	0

The intersection data show that of the various off- and on-ramps, three intersections were considered as High Accident Intersections. The northbound off-ramp to First Avenue and Seneca Street had an increase in accidents between 1998 and 1999. However, in 2000 it had less than 10 accidents. This may be due to the increase in volumes traveling through this intersection. The intersection at Denny Way and Dexter Avenue near the northbound Denny on-ramp to SR 99 had a decrease in accidents over the 3-year study period. The accidents were reduced by almost 50 percent between 1998 and 1999. This was primarily a result of minor channelization changes in the area. The unsignalized intersection at Bell Street and Western Avenue is the terminus of the northbound Western Avenue off-ramp and the Western Avenue on-ramp. The data shows that it met the minimum requirements for the 1998 High Accident Intersection, but for 1999 and 2000, the accidents were lower than the minimum.

Overall, the accidents at the intersections surrounding the terminus of SR 99 ramps have been minimal over the last couple of years.

4.10.4 Accidents and Safety Evaluation

MOE A1: Facility Design Features

The Build Alternatives are analyzed in Chapter 5 to assess their potential safety benefits or impacts. Major design elements, including facility type, lane widths, geometric configuration, and potential vehicle and pedestrian conflict locations, are identified. These design features are related to the existing high accident locations detailed in this section.

Chapter 5 OPERATIONAL IMPACTS AND BENEFITS

To gauge potential impacts to the transportation system and assess transportation performance, SR 99 and related transportation systems were analyzed under 2030 forecasted conditions. These future transportation system conditions were established based on forecasts of regional population and employment, socioeconomic conditions, and transportation system pricing (parking, tolls, fares) developed by the PSRC and reflected in its EMME/2 travel demand model. In addition, the future conditions presume a limited number of new transportation facilities and services by 2030.

A 2030 Existing Facility scenario was investigated that presumes the current configuration of SR 99 against the backdrop of forecasted 2030 conditions. This scenario serves to establish baseline information for system performance against which conditions for each of the project alternatives may be compared. Analysis of alternatives is conducted through investigation of a range of Measures of Effectiveness, which cover the range of modal components (e.g., highways, arterial streets, transit, non-motorized movement, ferries, and freight movement), as well as issues such as safety and construction impacts.

5.1 Alternatives Overview

The project alternatives are described in detail in Appendix B, Alternatives Description and Construction Methods Technical Memorandum. In addition to the 2030 Existing Facility scenario, five Build Alternatives are assessed in this study. These alternatives include Rebuild and Aerial Alternatives, both of which will reconstruct SR 99 on an aerial structure through downtown Seattle; Tunnel and Bypass Tunnel Alternatives, which will reconstruct SR 99 in tunnel segments through downtown; and a Surface Alternative, which will replace the existing viaduct downtown with an urban arterial street. The five Build Alternatives also have options, or segments of alternatives that could be built differently (as mix-and-match components). Information regarding performance of options is provided in cases where the transportation operations of the proposed option would vary substantively from the primary alternative.

Brief overviews of the project alternatives are outlined below. For a more complete description of the alternatives, refer to Appendix B, Alternatives Description and Construction Methods Technical Memorandum.

5.1.1 2030 Existing Facility Scenario

The Alaskan Way Viaduct and Seawall Replacement Project considers three 2030 No Build scenarios, given the unpredictability associated with the long-term structural viability of the facility:

- Scenario 1 – Continued operation of the viaduct and seawall with continued maintenance.
- Scenario 2 – Sudden unplanned loss of the viaduct and/or seawall but without major collapse or injury.
- Scenario 3 – Catastrophic failure and collapse of the viaduct and/or seawall.

This Transportation Discipline Report analyzes traffic and transportation conditions consistent with Scenario 1 to allow for comparison of the Build Alternatives to the current facility, but under 2030 traffic conditions. This scenario is referred to in this report as the 2030 Existing Facility scenario. While this scenario is useful for assessing the performance and impacts of the Build Alternatives relative to the facility that is in place today, it should be recognized that the current facility is reaching the end of its service life and is unlikely to remain in satisfactory condition for use for the long term.

Implications of No Build Failure Scenarios

Failure of the existing Alaskan Way Viaduct structure as described under Scenarios 2 and 3 above would have severe consequences in terms of mobility, access to waterfront businesses and uses, and traffic congestion in and around downtown Seattle. While the full implications to the transportation system are unknown, loss of the SR 99 corridor would force more than 20 percent of all traffic passing through or traveling to and from downtown Seattle to use other routes. The existing conditions analysis presented in Chapter 4, Affected Environment, shows that most facilities in the downtown currently operate at or near capacity during peak hours, and the analysis presented in this chapter shows that these conditions will worsen in coming years as the region continues to grow.

Another primary impact associated with loss of the SR 99 corridor through downtown would be reduced (or eliminated) access to the waterfront area in the event of collapse of the seawall or viaduct as defined in Scenario 3. Waterfront businesses, ferry service at Colman Dock, and other uses dependent on access to the waterfront could all be affected.

Users of the SR 99 corridor, including freight carriers, would be affected by substantially increased travel times under Scenarios 2 or 3. Travel between areas west of SR 99 would especially be affected, since no other regional highway directly serves these areas. Travel times on other streets and on I-5 would also increase considerably due to the increased congestion caused by displaced SR 99 traffic.

5.1.2 Rebuild Alternative

The Rebuild Alternative will include a combination of new construction, rebuild and retrofit of the Alaskan Way Viaduct, and a rebuild of the seawall. The alignment for the Rebuild Alternative will generally follow the existing SR 99 alignment from S. Holgate Street to the Battery Street Tunnel.

The Rebuild Alternative will accommodate traffic in much the same way as the current SR 99 corridor. SR 99 will contain three to four northbound and three southbound lanes between S. Hanford Street in the south and the southbound Elliott on-ramp and northbound Western off-ramp near the Battery Street Tunnel in the north. Just south of the Battery Street Tunnel, the southbound off-ramp and northbound on-ramp to and from Western Avenue will be closed due to geometric deficiencies. The corresponding northbound off-ramp and southbound on-ramp will be maintained in much the same way as today. Also like today, access to downtown will be provided northbound by a Seneca Street off-ramp and southbound by a Columbia Street on-ramp. No downtown access will be provided to and from the north. Near the stadium area, access will be relocated and expanded compared to the current configuration. The First Avenue S. ramps (to and from the north) will be removed, and a new full interchange will be provided at S. Royal Brougham Way and S. Atlantic Street, west of First Avenue.

North of the Battery Street Tunnel, the existing configuration will be maintained. Refer to Chapter 4, Affected Environment, for a complete description of the current configuration.

(Note: The transportation analysis presented in this study presumed no new connections provided at King Street under the Rebuild Alternative. Connections to downtown would only be provided by the Columbia and Seneca Street ramps, as they are today. Other analysis in support of the DEIS considered a new northbound off-ramp at King Street in addition to the Seneca Street off-ramp. The transportation related effects of including this additional off-ramp would be negligible, and limited to potential minor changes to specific intersection operations. The addition of ramps at King Street is fully examined under the Tunnel and Bypass Tunnel alternatives.)

5.1.3 Aerial Alternative

The Aerial Alternative will include constructing a new aerial structure between S. Walker Street and the existing Battery Street Tunnel, retrofitting and upgrading the Battery Street Tunnel for fire/life safety improvements north of the Battery Street Tunnel, and rebuilding the existing Seattle seawall.

The Aerial Alternative will provide similar connections and lane configurations as the Rebuild Alternative, with a few important differences:

- Full access will be provided at S. Royal Brougham Way and S. Atlantic Street, though a different design configuration will be used.
- Access downtown and to Elliott Avenue and Western Avenue is similar as well, though the southbound segment between the Columbia on-ramp and new S. Royal Brougham Way off-ramp will include an additional lane (four total southbound lanes in this segment).
- A Widened Mercer Underpass will be constructed north of the Battery Street Tunnel. The Mercer Street undercrossing will be widened to provide three lanes in each direction and a center turn lane (seven lanes total) from Fifth Avenue to Dexter Avenue. A second grade-separated crossing of SR 99 will be provided at Thomas Street, helping to reconnect the arterial grid in the South Lake Union area. The existing southbound off-ramp to Broad Street and northbound off-ramp to Mercer Street will be removed. Access will be provided by right-turn-only intersections (as configured today) and the Denny Way ramps.

5.1.4 Tunnel Alternative

The Tunnel Alternative will replace the existing SR 99 Alaskan Way Viaduct with a new six-lane roadway (three lanes in each direction) from S. Hanford Street to Pike Street, located generally along the alignment of the existing SR 99 corridor. At Pike Street, the mainline will diverge from the seawall along the waterfront with a new four-lane (two lanes in each direction) connection to the existing Battery Street Tunnel. A northbound off-ramp and southbound on-ramp to and from Alaskan Way surface street will replace the function of the existing Elliott Avenue and Western Avenue ramps. Traffic continuing toward the Ballard and Interbay areas will use a new underpass beneath the BNSF rail line (an independent project that is considered part of the project baseline conditions).

No ramps will be provided in the tunnel segment to downtown. Instead, access will be provided by a new northbound off-ramp and southbound on-ramp to and from Alaskan Way surface street in the vicinity of King Street. Traffic destined for downtown will use an expanded Alaskan Way to distribute traffic to the downtown streets from the new King Street ramps.

At S. Royal Brougham Way and S. Atlantic Street, full access will be provided using the same configuration as the Rebuild Alternative.

North of the Battery Street Tunnel, the Tunnel Alternative will have the same configuration as described for the Aerial Alternative.

Under the Tunnel Alternative, Western Avenue would be reconfigured to operate as a one-way northbound street between Alaskan Way (near Yesler Way) and approximately Seneca Street.

5.1.5 Bypass Tunnel Alternative

The Bypass Tunnel Alternative will replace the existing SR 99 Alaskan Way Viaduct with an expanded Alaskan Way surface street coupled with a four-lane tunnel that will accommodate the SR 99 mainline through downtown. Like the other alternatives, the Bypass Tunnel Alternative will provide full access at S. Royal Brougham Way and S. Atlantic Street. As with the Tunnel Alternative, ramps to and from S. King Street will provide access to downtown. Unique to the Bypass Tunnel Alternative is that only two lanes are provided in each direction between the King Street ramps and the Battery Street Tunnel, as no ramps are provided at Elliott Avenue or Western Avenue. Thus, the King Street ramps and Alaskan Way surface street will also accommodate trips that formerly used the Elliott Avenue and Western Avenue ramps. Traffic continuing toward the Ballard and Interbay areas will use a new underpass beneath the BNSF rail line (an independent project that is considered part of the project baseline conditions).

North of the Battery Street Tunnel, the Bypass Tunnel Alternative will have the same configuration as described for the Aerial Alternative.

Under the Bypass Tunnel Alternative, Western Avenue would be reconfigured to operate as a one-way northbound street between Alaskan Way (near Yesler Way) and approximately Seneca Street.

5.1.6 Surface Alternative

The Surface Alternative will replace the existing SR 99 Alaskan Way Viaduct with a surface urban arterial through downtown. An expanded Alaskan Way surface street will replace SR 99 between S. King Street and Pike Street. The surface arterial will consist of eight lanes (four lanes in each direction) south of Yesler Way, and six lanes between Yesler Way and Pike Street. A new intersection near Pike Street will connect the northern segment of Alaskan Way to the SR 99 mainline. North of Pike Street, the mainline will climb to the Battery Street Tunnel, with a northbound off-ramp and southbound on-ramp provided at Western Avenue and Elliott Avenue respectively.

South of downtown, the Surface Alternative will transition to a limited access design similar to the Rebuild, Tunnel, and Bypass Tunnel Alternatives. A full interchange will provide access in all directions at S. Royal Brougham Way and S. Atlantic Street. North of the Battery Street Tunnel, the Surface Alternative will have the same configuration as described for the Aerial Alternative.

Under the Surface Alternative, Western Avenue would be reconfigured to operate as a one-way northbound street between Alaskan Way (near Yesler Way) and approximately Seneca Street. Also, to help offset capacity reductions on the SR 99 corridor, First Avenue S. through Pioneer Square would be opened to four lanes of traffic during the peak commuting periods.

5.2 Year 2030 Traffic Forecasts

5.2.1 2030 Traffic Forecasts

The 2030 Existing Facility and Build Alternatives are assessed under 2030 traffic conditions. The analysis presumes increased levels of traffic by the year 2030 as a result of forecasted increases in population and employment in the Puget Sound region. Estimated traffic volumes for 2030 are based on travel demand modeling conducted using a version of the PSRC EMME/2 model that was enhanced within the study area to better reflect the existing roadway network and transit services. This model, and its Build Alternative counterparts, will be referred to as the AWV model throughout this report.

Detailed traffic operational analysis of the alternatives is based on traffic volumes forecasted for the PM peak hour, which corresponds to the hour during the evening commute when the highest levels of traffic are expected. PM peak hour traffic was estimated based on adjustment of existing traffic estimates to reflect the growth and changes in traffic patterns forecasted by the AWV model. Some additional system comparison measures use daily traffic volume estimates directly from the AWV model. Chapter 2, Methodology, provides more detailed information on the procedures used to develop these traffic estimates.

Mode Share

By 2030, the AWV model forecasts increased traffic on regional highways and arterials, as well as substantial increases in the use of transit. In the downtown Seattle area in particular, the model forecasts very high use of non-automobile transportation modes (primarily transit services, but also accounting for transportation demand management [TDM] programs and nonmotorized transportation). Forecasted increases in non-automobile modes in downtown are so great that the model estimated they would offset increases in traffic resulting from growth in the downtown area. By 2030, the AWV model forecasted that 55 percent of all person-trips to or from downtown Seattle would be by automobiles, down from 77 percent today.

Regionally (all of King, Pierce, Snohomish, and Kitsap Counties), use of transit and other non-auto modes is also expected to increase sharply relative to current use (nearly doubling), but automobile trips will continue to predominate regionally in 2030. Exhibit 5-1 summarizes the model forecasted mode share for current and 2030 conditions.

Exhibit 5-1. Modeled Daily Transit Ridership

	Downtown Seattle		Region (King, Pierce, Snohomish, and Kitsap Counties)	
	Existing	2030	Existing	2030
Auto (SOV + HOV)	77%	55%	97%	95%
Transit (Non-Auto Modes)	23%	45%	3%	5%

A risk associated with the modeled increase in transit mode share is that should actual ridership not increase to the levels forecasted, actual growth in automobile traffic could outpace the forecasts. This risk was assessed, and it was determined that lower than forecasted levels of transit ridership could result in some underestimate of traffic volumes on local streets, but regional facilities such as SR 99 would be less affected by moderate variations in mode share. These findings are presented in Section 2.3.3 of the Methodology chapter.

The AWV model does not forecast any notable shift in travel modes across the alternatives studied. Several factors likely contribute to the uniformity of mode share forecasts between the alternatives:

- Transit service assumptions are consistent across alternatives. The same general transit services were presumed for each alternative.
- Transit ridership forecasts for 2030 in the downtown area are very high. The potential for remaining automobile trips to be accommodated by transit decreases as transit's mode share increases; i.e., transit ridership is nearing potential maximum levels downtown. Therefore, even if conditions are more favorable for transit under a particular scenario, increases in ridership may be minimal.
- Traffic delays affect bus service as well as automobiles. Increased highway delay might increase the relative desirability for transit service in cases where the transit services are not affected (i.e., fixed or exclusive guideway services). However, increased roadway delay also affects bus travel times and reliability, and can offset any relative benefit experienced by unaffected transit services.

5.2.2 Mainline and Ramp Volumes

Detailed PM peak hour traffic estimates for the 2030 Existing Facility and Build Alternatives were developed for SR 99 through the study area. Traffic volumes are presented for each connection to SR 99 (ramps or side streets), as well as each mainline segment (section of SR 99 between connections). Year 2030 traffic volumes are estimated based on the current volumes, which were adjusted to reflect growth and traffic redistribution forecasted by the AWV model.

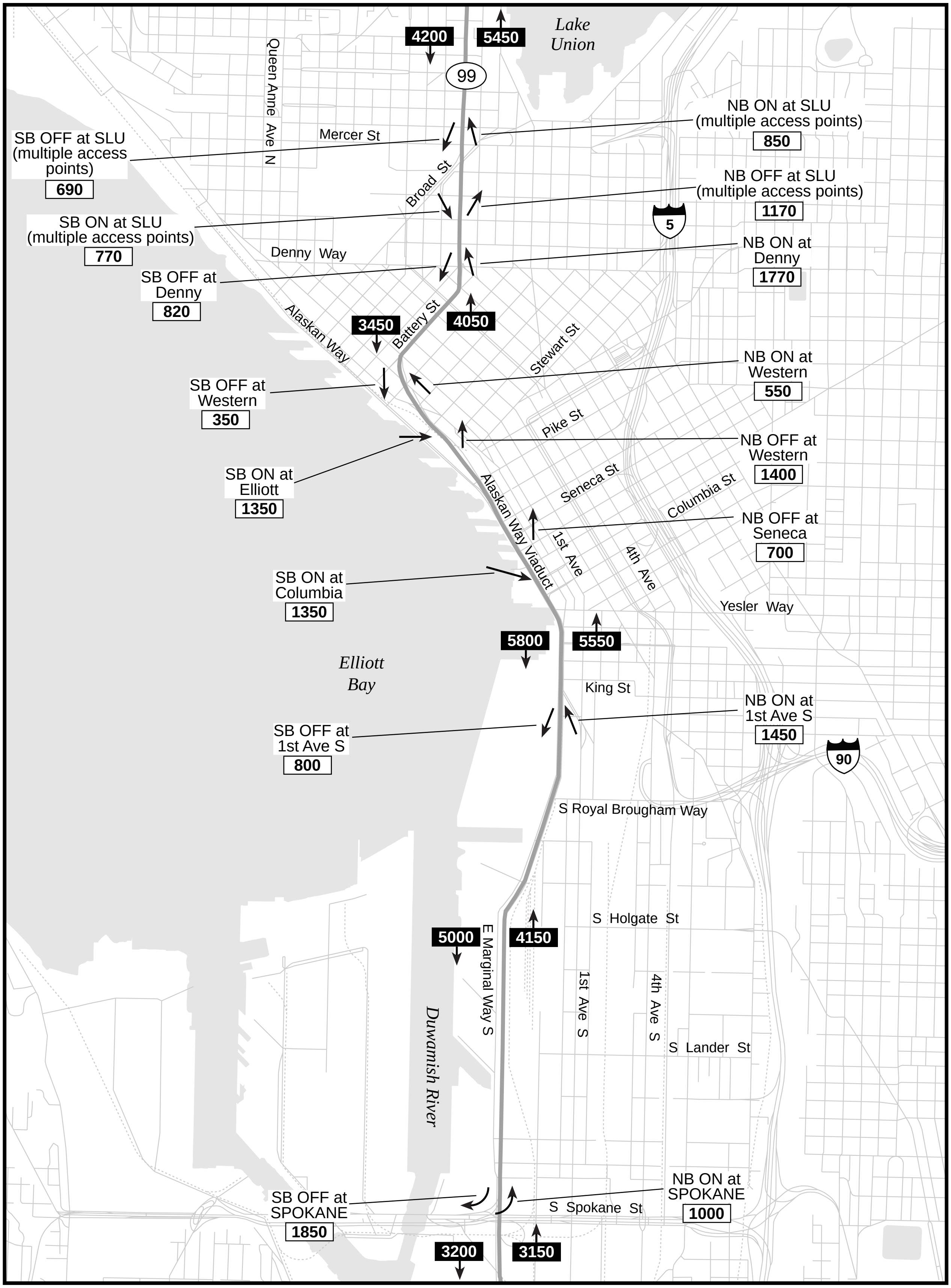
2030 Existing Facility

At the north end of the study area, PM peak hour mainline volumes are expected to be higher in the northbound direction, as more vehicles would be leaving the downtown area (5,450 vehicles) than would be coming in to town (4,200 vehicles). Forecasted northbound on-ramp volumes at Denny Way (1,770 vehicles) exceed those on the southbound off-ramp (820 vehicles). In the Battery Street Tunnel, the forecasted volume of northbound vehicles (4,050 vehicles) again exceeds the volume of southbound vehicles (3,450 vehicles).

Ramps at Elliott/Western Avenues providing access to and from the north show directionality as well, with 550 vehicles forecasted entering northbound but only 350 vehicles exiting southbound. However, the ramps to and from the south are expected to be balanced, with 1,350 vehicles entering southbound and 1,400 vehicles exiting northbound. The downtown ramps providing access to and from the south show the opposite directionality as those to the north, with more vehicles forecasted entering southbound at Columbia (1,350 vehicles) than those exiting northbound at Seneca (700 vehicles). The First Avenue S. ramps show similar directionality, with 1,450 vehicles forecasted entering northbound but only 800 vehicles exiting southbound. South of downtown and the stadium area, mainline volumes are forecasted to be substantially higher in the southbound direction (5,000 vehicles) than the northbound direction (4,150 vehicles). At Spokane Street, volumes exiting southbound to West Seattle (1,850 vehicles) exceed those entering northbound from West Seattle (1,000 vehicles). PM peak hour mainline and ramp volumes forecasted for the 2030 Existing Facility scenario are shown in Exhibit 5-2.

Rebuild Alternative

The Rebuild Alternative is very similar to the 2030 Existing Facility. Consequently, the mainline and ramp volumes anticipated for the Rebuild Alternative are also very similar to the 2030 Existing Facility. At the north end of the study area, the mainline volume is anticipated to be the same or very similar to the 2030 Existing Facility in both directions. Because the Rebuild



0 2,500
SCALE IN FEET
N

XXX Ramp Volumes

XXX SR-99 Mainline Volumes

Exhibit 5-2
PM Peak Hour Mainline and Ramp Volumes
2030 Existing Facility Scenario

Alternative does not include a northbound on-ramp or southbound off-ramp at Western, the volumes in the Battery Street Tunnel in both directions are anticipated to be slightly lower than the 2030 Existing Facility. The vehicles that would have used those ramps are expected to instead use connections provided in the South Lake Union area, particularly the northbound on- and southbound off-ramps at Denny, both of which would have increased volumes over the 2030 Existing Facility. The northbound off-ramp and southbound on-ramp at Elliott/Western, as well as the Seneca and Columbia ramps downtown, are anticipated to have similar volumes to the 2030 Existing Facility. The ramps at SR 519 to and from the north are anticipated to have increased volumes over the corresponding ramps in the 2030 Existing Facility (First Avenue S. ramps), due to the improved connection to I-90. The new connection to and from the south provided at SR 519 is anticipated to result in an increase in mainline volumes in both directions south of the stadium area and the ramps to and from West Seattle, as drivers take advantage of the new connection to I-90. PM peak hour mainline and ramp volumes forecasted for the Rebuild Alternative are shown in Exhibit 5-3.

Aerial Alternative

Like the Rebuild Alternative, the mainline and ramp volumes anticipated for the Aerial Alternative are similar to the 2030 Existing Facility. At the north end of the study area, the mainline volume is anticipated to be the same as or very similar to the 2030 Existing Facility in both directions. Because the Aerial Alternative does not include a northbound on-ramp at Western, the northbound volume in the Battery Street Tunnel is anticipated to be slightly lower than the 2030 Existing Facility. The southbound direction is expected to be similar to the 2030 Existing Facility. Those vehicles that would have used the Elliott/Western ramps to and from the north are expected to instead use connections provided in the South Lake Union area, particularly the northbound on- and southbound off-ramps at Denny, both of which would have increased volumes over the 2030 Existing Facility. The northbound off-ramp and southbound on-ramp at Elliott/Western, as well as the Seneca and Columbia ramps downtown, are anticipated to have similar volumes to the 2030 Existing Facility. The ramps at SR 519 to and from the north are anticipated to have increased volumes over the corresponding ramps in the 2030 Existing Facility (First Avenue S. ramps), due to the improved connection to I-90. The new connection to and from the south provided at SR 519 is anticipated to result in an increase in mainline volumes in both directions south of the stadium area and the ramps to and from West Seattle, as drivers take advantage of the new connection to I-90. PM peak hour mainline and ramp volumes forecasted for the Aerial Alternative are shown in Exhibit 5-4.

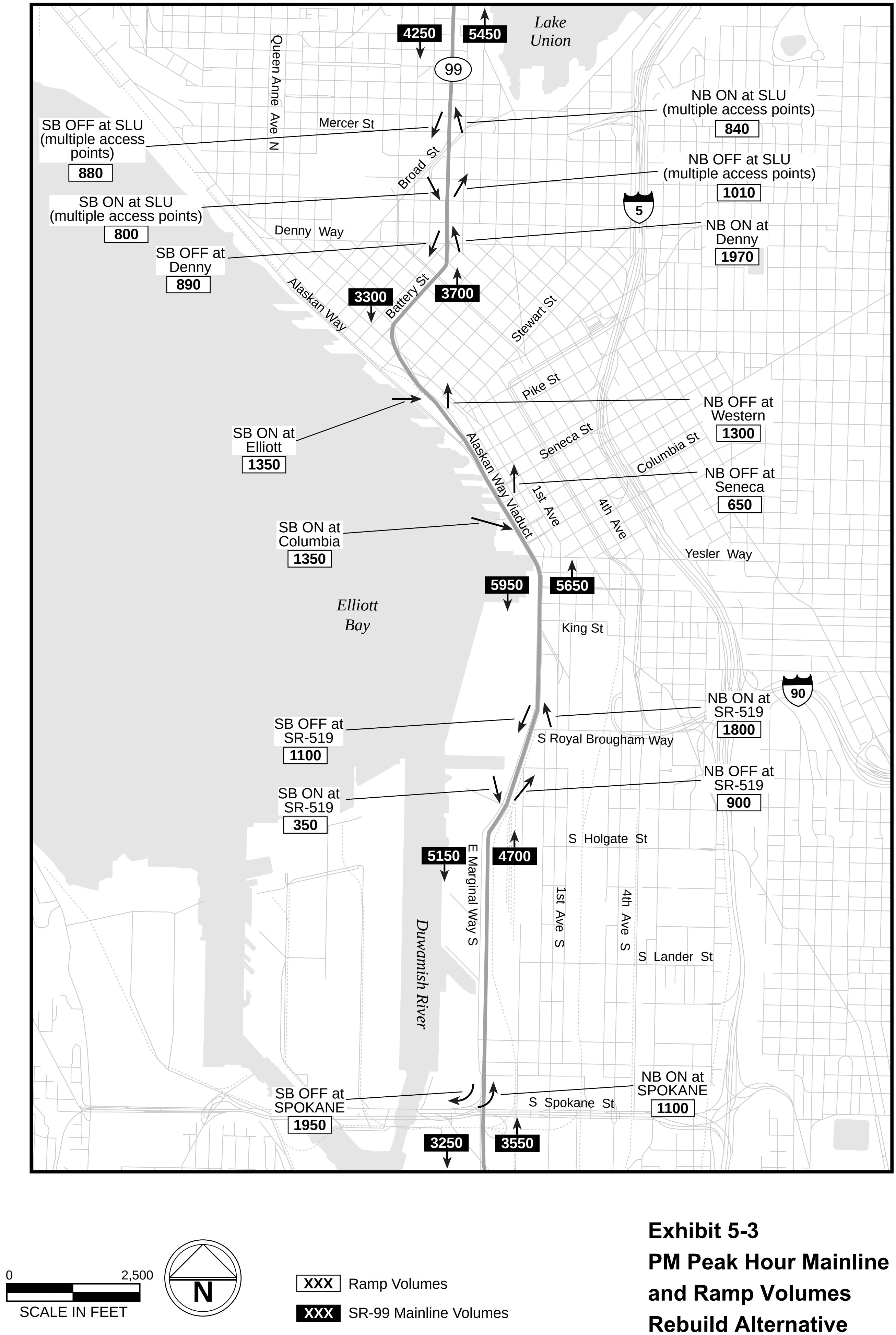


Exhibit 5-3
PM Peak Hour Mainline and Ramp Volumes Rebuild Alternative

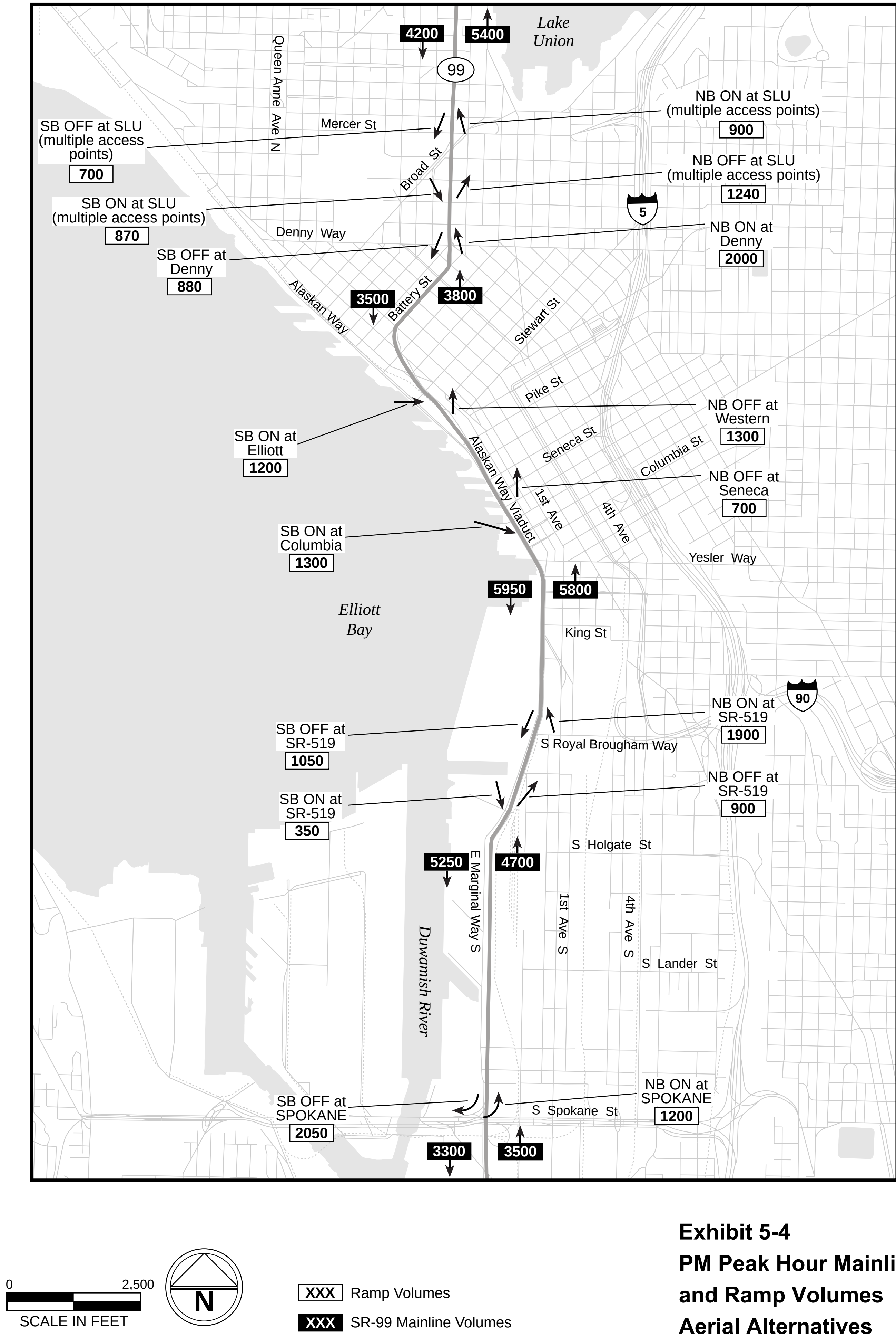


Exhibit 5-4
PM Peak Hour Mainline and Ramp Volumes Aerial Alternatives

Tunnel Alternative

At the north end of the study area, mainline volumes in the Tunnel Alternative are anticipated to be similar to the 2030 Existing Facility in both directions. Entering and exiting volumes in the South Lake Union area, including the ramps at Denny, are expected to generally increase over the 2030 Existing Facility volumes in both directions. This is mainly due to the absence of northbound on- and southbound off-ramps at Elliott/Western. Volumes in the Battery Street Tunnel are anticipated to be similar to the 2030 Existing Facility in the northbound direction and slightly higher than the 2030 Existing Facility in the southbound direction. For connections to and from the south in the Elliott/Western area, the existing ramps will be replaced in the Tunnel Alternative with ramps connecting to Alaskan Way on the waterfront. The northbound off-ramp volume is expected to be similar to the 2030 Existing Facility, while the southbound on-ramp volume is expected to be lower than the 2030 Existing Facility. Unlike the Rebuild or Aerial Alternatives, the Tunnel Alternative will not include ramps at Seneca orColumbia. Ramps at King Street will provide the closest connection to downtown from the south. The southbound on-ramp volume at King Street is expected to be similar to the 2030 Existing Facility ramp at Columbia, while the northbound off-ramp volume is expected to be lower than the 2030 Existing Facility ramp at Seneca. In the stadium area, the ramps at SR 519 to and from the north are anticipated to have increased volumes over the corresponding ramps in the 2030 Existing Facility (First Avenue S. ramps), due to the improved connection to I-90. The new connection to and from the south provided at SR 519 is anticipated to result in an increase in mainline volumes in both directions south of the stadium area (particularly northbound) and the ramps to and from West Seattle, as drivers take advantage of the new connection to I-90. PM peak hour mainline and ramp volumes forecasted for the Tunnel Alternative are shown in Exhibit 5-5.

Bypass Tunnel Alternative

At the north end of the study area, mainline volumes in the Bypass Tunnel Alternative are anticipated to be slightly lower than the 2030 Existing Facility in the northbound direction and higher than the 2030 Existing Facility in the southbound direction. Entering and exiting volumes in the South Lake Union area are generally expected to be higher than the 2030 Existing Facility, with the exception of traffic exiting the mainline in the northbound direction. Mainline volumes in the Battery Street Tunnel are anticipated to be higher than the 2030 Existing Facility, particularly in the southbound direction. This is mainly due to the absence of ramps in the Elliott/Western area. Vehicles

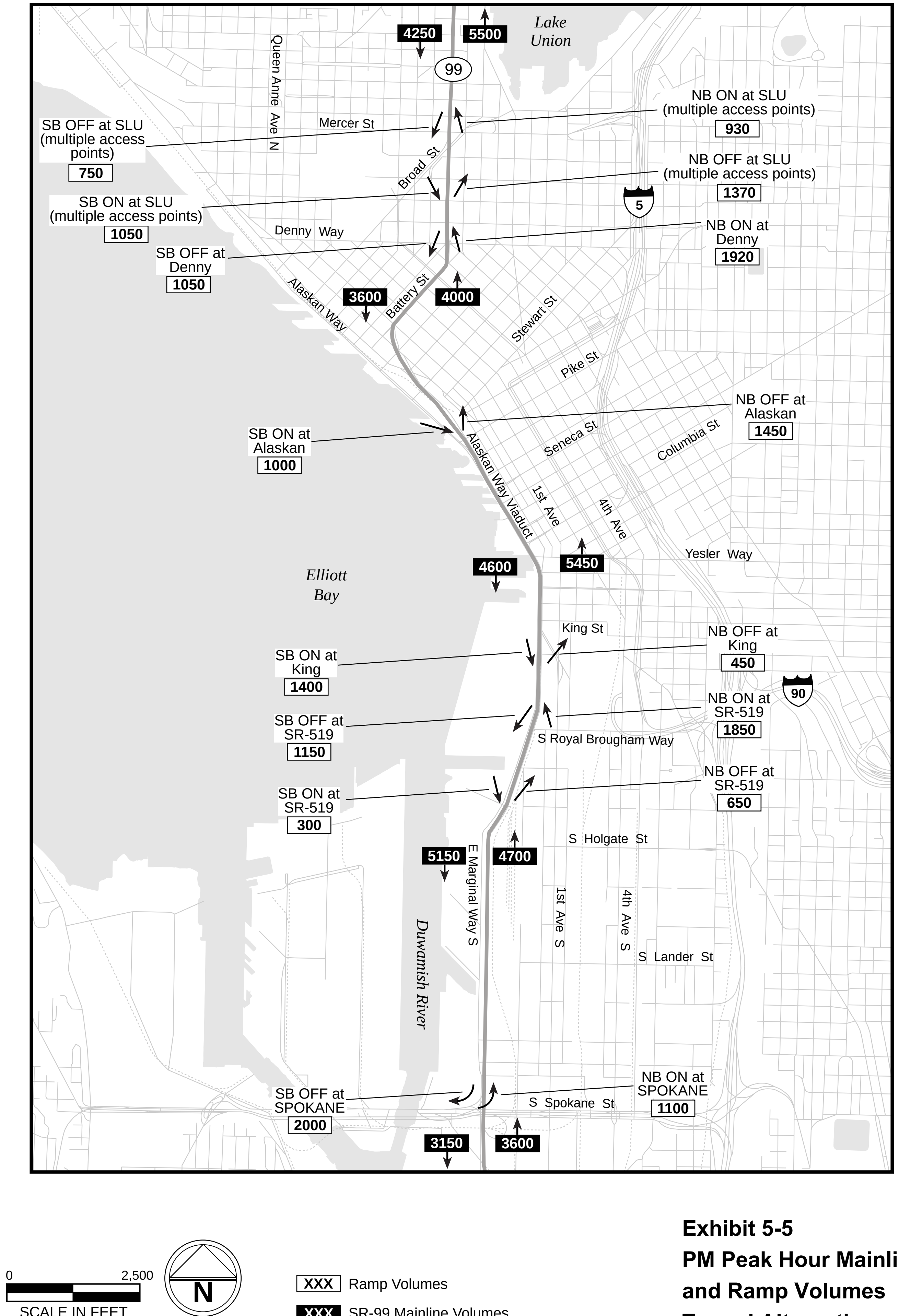


Exhibit 5-5
PM Peak Hour Mainline and Ramp Volumes Tunnel Alternative

that enter southbound at Elliott in the 2030 Existing Facility, in particular, are expected to enter either at South Lake Union or travel along Alaskan Way on the waterfront and enter the mainline at King Street. As in the Tunnel Alternative, the Bypass Tunnel Alternative will not include ramps at Seneca or Columbia. Ramps at King Street will provide the closest connection to downtown from the south. Volumes on both the southbound on-ramp and the northbound off-ramp at King Street are anticipated to be higher than those at the Seneca and Columbia ramps in the 2030 Existing Facility. In the stadium area, the ramps at SR 519 to and from the north are anticipated to have increased volumes over the corresponding ramps in the 2030 Existing Facility (First Avenue S. ramps), due to the improved connection to I-90. The new connection to and from the south provided at SR 519 is anticipated to result in an increase in mainline volumes in both directions south of the stadium area (particularly northbound) and the ramps to and from West Seattle, as drivers take advantage of the new connection to I-90. PM peak hour mainline and ramp volumes forecasted for the Bypass Tunnel Alternative are shown in Exhibit 5-6.

Surface Alternative

Mainline volumes for the Surface Alternative are anticipated to be lower than those in the 2030 Existing Facility in both directions throughout the study area. This is a result of a general decrease in capacity on SR 99 through the central part of the corridor. At the north end of the study area, the mainline volumes are expected to be considerably lower than the 2030 Existing Facility in both directions. In the South Lake Union area, it is anticipated that northbound entering volumes and southbound exiting volumes will be higher than the 2030 Existing Facility, as vehicles seek alternatives to the mainline for access to and from downtown.

Conversely, northbound exiting volumes and southbound entering volumes are expected to be lower than the 2030 Existing Facility as fewer vehicles use the mainline through the central corridor. Volumes in both directions in the Battery Street Tunnel are anticipated to be considerably lower than the 2030 Existing Facility.

As with all of the alternatives, the existing Elliott/Western ramps providing access to and from the north will not be replaced in the Surface Alternative. Traffic volumes on the Elliott/Western ramps to and from the south are expected to be lower than with the 2030 Existing Facility. However, volumes entering and exiting the mainline at Alaskan Way along the waterfront, combined with the volumes using the Elliott/Western ramps to and from the south, are expected to be similar to the volumes on the Elliott/Western ramps

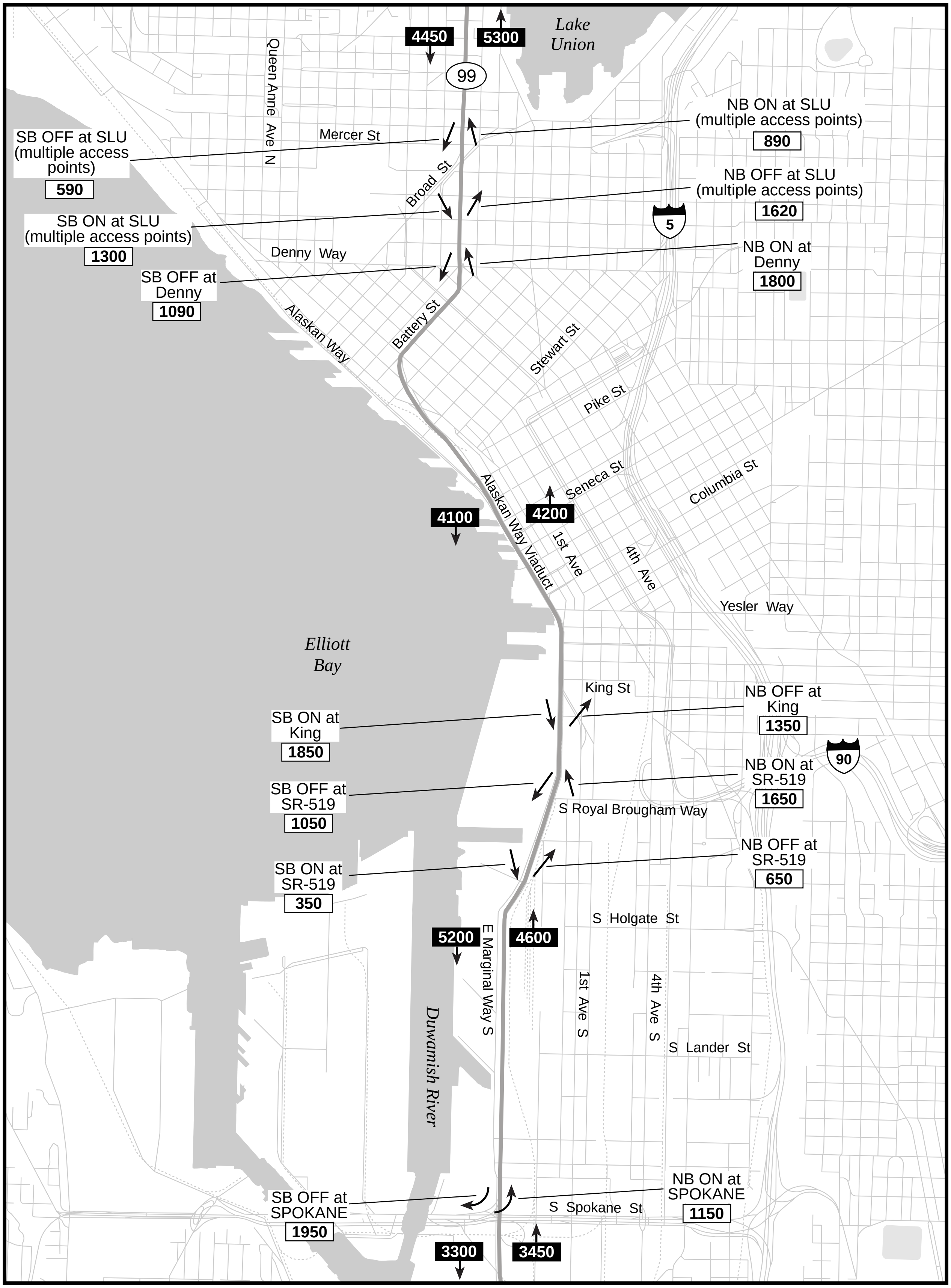


Exhibit 5-6
PM Peak Hour Mainline and Ramp Volumes
Bypass Tunnel Alternative

to and from the south in the 2030 Existing Facility. In the downtown area, the existing Seneca and Columbia ramps would not be replaced in the Surface Alternative. Instead, access would be provided via Alaskan Way along the waterfront. Entering and exiting volumes on Alaskan Way are expected to be higher than those using the Seneca and Columbia ramps in the 2030 Existing Facility; however, these volumes are not directly comparable as there would be some turning movement volumes on Alaskan Way in the 2030 Existing Facility as well. In the stadium area, the ramps at SR 519 to and from the north are anticipated to have increased volumes over the corresponding ramps in the 2030 Existing Facility (First Avenue S. ramps), due to the improved connection to I-90. The new connection to and from the south provided at SR 519 would result in a less substantial decrease on the mainline south of the stadium area. Volumes entering northbound from West Seattle are expected to be similar to the 2030 Existing Facility, while volumes exiting southbound to West Seattle are anticipated to be lower than the 2030 Existing Facility. PM peak hour mainline and ramp volumes forecasted for the Surface Alternative are shown in Exhibit 5-7.

5.2.3 Arterial and Local Street Forecasts

Traffic estimates for selected links and intersections on arterials and local streets within the study area were developed so that analysis of traffic operations could be assessed. The intersections selected for the study are shown in Exhibit 2-12 and include all ramp termini, as well as congested or high-volume intersections.

Intersection turning movement data is documented in the AWV Project Data Documentation Reports (Parsons Brinckerhoff 2003).

5.3 Highway-Related Measures of Effectiveness

5.3.1 SR 99 Connections

MOE H1: SR 99 Connections

Key Findings

- All alternatives will improve connections (compared to existing conditions or the 2030 Existing Facility scenario) to SR 519 and local streets in the stadium area by providing access to southbound SR 99 and from northbound SR 99.

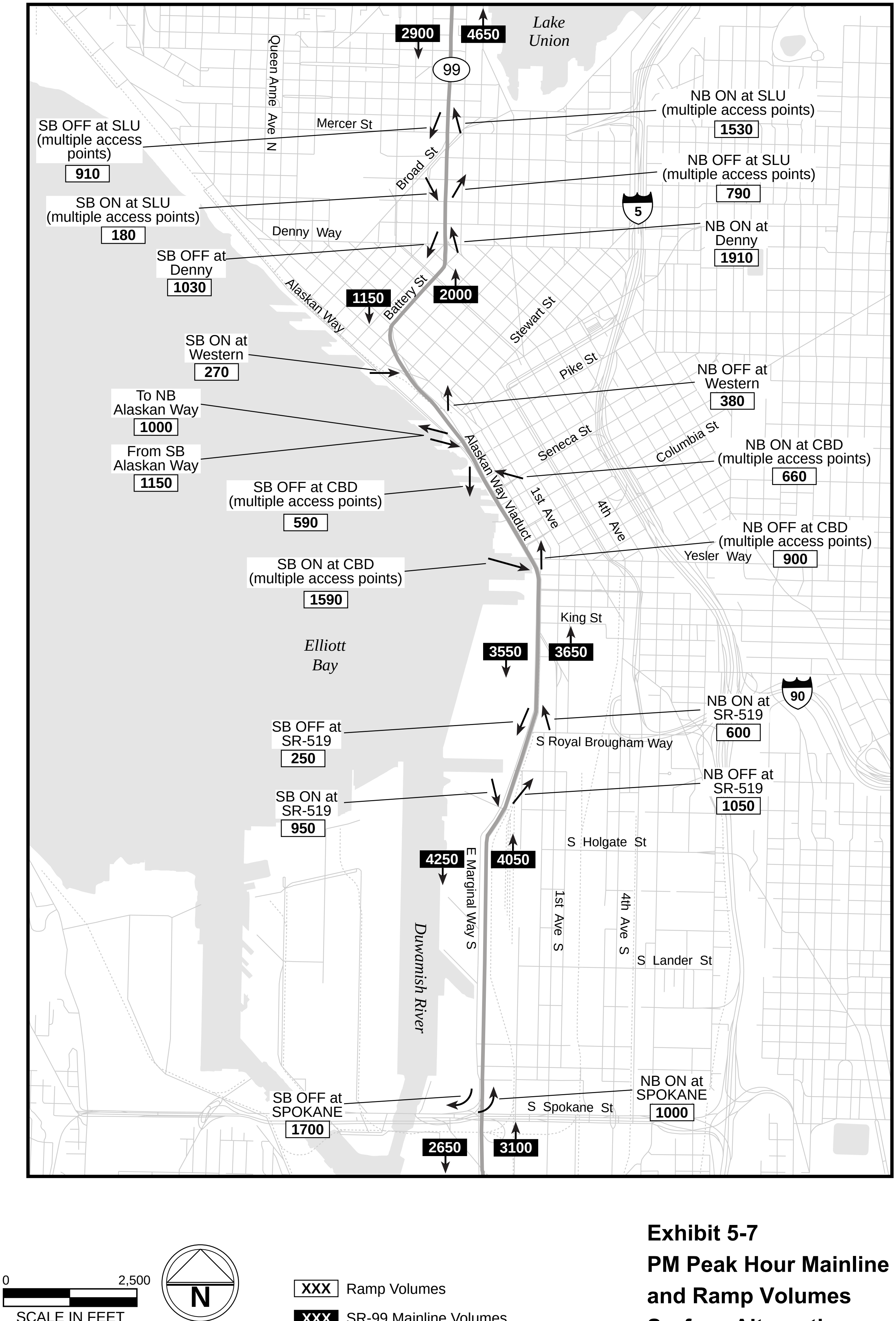


Exhibit 5-7
PM Peak Hour Mainline and Ramp Volumes Surface Alternative

- Connectivity to/from downtown, while provided in differing ways, will be similar to that currently provided for the Rebuild, Aerial, Tunnel, and Bypass Tunnel Alternatives. The Surface Alternative, which will allow for a greater variety of possible movements at intersections on SR 99, will improve connectivity downtown compared to other alternatives, since traffic from southbound or to northbound SR 99 could directly access downtown from the corridor.
- Connectivity to the Elliott Avenue/Western Avenue corridor will decrease under the Rebuild, Aerial, Tunnel, and Bypass Tunnel Alternatives, since the Battery Street ramps to northbound SR 99 and from southbound SR 99 will not be provided. These ramps will also not be provided under the Surface Alternative, though the connection could still be made (less directly) at a signalized intersection on the SR 99 mainline at Alaskan Way. To and from the south, direct connections will not be provided by the Bypass Tunnel Alternative to the Elliott Avenue/Western Avenue corridor, though the King Street ramps and Alaskan Way will provide for this movement in a less direct manner. Connectivity to and from the south was rated as good for the Rebuild, Aerial, Tunnel, and Surface Alternatives. The Tunnel Alternative will move the connection to Alaskan Way, which was considered to provide equivalent connectivity.
- Connectivity in the South Lake Union area involves trade-offs, with advantages and disadvantages for each concept studied. The Widened Mercer Street that is a component of the Aerial, Tunnel, Bypass Tunnel, and Surface Alternatives will decrease the quality of exiting connections (removing two off-ramps) compared to the existing configuration. However, access to/from the connection points from the grid system will be greatly expanded under this configuration.

MOE H1, SR 99 Connections, gauges the interface between the SR 99 corridor and other streets and highways in the study area. This assessment looks at potential connections at locations on the corridor where connections are currently provided:

- To/from the stadium area and SR 519
- To/from Belltown/Interbay
- To/from downtown Seattle
- To/from the South Lake Union area

Connections provided under the 2030 Existing Facility and each of the Build Alternatives were evaluated by the degree of connectivity provided (whether connections are provided for all potential movements or just for specific movements), the type of connection provided (ramps or arterial connections), and the directness of the connection. These measures were combined into a single score, presented here. The ratings represent the range of connectivity that is provided for each area, with a filled-in circle – ● – representing excellent connectivity (i.e., direct, efficient access provided to/from all directions of SR 99), while an empty circle – ○ – represents no or very poor connectivity. Successively more shaded circles – ◔, ◑, ◕ – represent increasingly higher level and quality of connectivity between the SR 99 corridor and the local street system.

Exhibit 5-8 summarizes the ratings of corridor connectivity, while details of the connections provided in existing conditions and under each alternative are provided in Exhibits 5-9 through 5-14.

Exhibit 5-8. Summary of Corridor Connectivity

	(2002/2030) Existing	Rebuild	Aerial	Tunnel	Bypass Tunnel	Surface
Stadium Area	◑	●	●	●	●	●
SB SR 99 to Stadium Area	Good	Good	Good	Good	Good	Good
Stadium Area to SB SR 99	None	Good	Good	Good	Good	Good
NB SR 99 to Stadium Area	None	Good	Good	Good	Good	Good
Stadium Area to NB SR 99	Good	Good	Good	Good	Good	Good
Downtown Seattle	◑	◑	◑	◑	◑	●
SB SR 99 to Downtown	None	None	None	None	None	Good
Downtown to SB SR 99	Fair/Good	Fair/Good	Good	Good	Good	Good
NB SR 99 to Downtown	Fair/Good	Fair/Good	Good	Good	Good	Good
Downtown to NB SR 99	None	None	None	None	None	Good
Elliott and Western Corridor	◕	◑	◑	◑	◔	◕
SB SR 99 to Elliott/Western	Fair	None	None	None	None	Fair
Elliott/Western to SB SR 99	Good	Good	Good	Good	Fair	Good
NB SR 99 to Elliott/Western	Good	Good	Good	Good	Fair	Good
Elliott/Western to NB SR 99	Fair	None	None	None	None	Fair
South Lake Union Area	◑	◑	◑	◑	◑	◑
SB SR 99 to west SLU	Good	Good	Good	Good	Good	Good
SB SR 99 to east SLU	Good	Good	Good	Good	Good	Good
West SLU to SB SR 99	Fair	Fair	Fair	Fair	Fair	Fair
East SLU to SB SR 99	Poor	Poor	Fair	Fair	Fair	Fair
NB SR 99 to west SLU	Poor	Poor	Fair	Fair	Fair	Fair
NB SR 99 to east SLU	Good	Good	Fair	Fair	Fair	Fair
West SLU to NB SR 99	Fair	Fair	Fair	Fair	Fair	Fair
East SLU to NB SR 99	Fair	Fair	Fair	Fair	Fair	Fair

SB = southbound, NB = northbound, SLU = South Lake Union

Exhibit 5-9. Connections Provided To/From SR 99 – Existing Facility

	Good Access	Partial or Substandard Access	No Access
Stadium Area			
SB SR 99 to Stadium Area	First Avenue Ramp (SB only)		
Stadium Area to SB SR 99			None
NB SR 99 to Stadium Area			None
Stadium Area to NB SR 99	First Avenue Ramp (NB only)		
Downtown Seattle			
SB SR 99 to Downtown			None
Downtown to SB SR 99	Columbia Street Ramp		
NB SR 99 to Downtown		Seneca Street Ramp (substandard)	
Downtown to NB SR 99			None
Elliott and Western Corridor			
SB SR 99 to Elliott/Western		Battery Street Ramp (substandard)	
Elliott/Western to SB SR 99	Elliott Avenue Ramp		
NB SR 99 to Elliott/Western	Western Avenue Ramp		
Elliott/Western to NB SR 99		Battery Street Ramp (substandard)	
South Lake Union Area			
SB SR 99 to west SLU	Denny Way Ramp		
Broad Street Ramp	Arterial Connections		
SB SR 99 to east SLU	Denny Way Ramp	Broad Street Ramp (via Mercer Street)	
West SLU to SB SR 99		Arterial Connections	
East SLU to SB SR 99			Indirect
NB SR 99 to west SLU			Indirect
NB SR 99 to east SLU	Mercer/Dexter Ramp	Arterial Connections	
West SLU to NB SR 99		Arterial Connections (via Mercer Street)	
East SLU to NB SR 99		Arterial Connections	

Exhibit 5-10. Connections Provided To/From SR 99 – Rebuild Alternative

	Good Access	Partial or Substandard Access	No Access
Stadium Area			
SB SR 99 to Stadium Area	SR 519 Interchange		
Stadium Area to SB SR 99	SR 519 Interchange		
NB SR 99 to Stadium Area	SR 519 Interchange		
Stadium Area to NB SR 99	SR 519 Interchange		
Downtown Seattle			
SB SR 99 to Downtown			None
Downtown to SB SR 99	Columbia Street Ramp		
NB SR 99 to Downtown		Seneca Street Ramp (substandard)	
Downtown to NB SR 99			None
Elliott and Western Corridor			
SB SR 99 to Elliott/Western			None (emergency only)
Elliott/Western to SB SR 99	Elliott Avenue Ramp		
NB SR 99 to Elliott/Western	Western Avenue Ramp		
Elliott/Western to NB SR 99			None (emergency only)
South Lake Union Area			
SB SR 99 to west SLU	Denny Way Ramp		
Broad Street Ramp	Arterial Connections		
SB SR 99 to east SLU	Denny Way Ramp	Broad Street Ramp (via Mercer Street)	
West SLU to SB SR 99		Arterial Connections	
East SLU to SB SR 99			Indirect
NB SR 99 to west SLU			Indirect
NB SR 99 to east SLU	Mercer/Dexter Ramp	Arterial Connections	
West SLU to NB SR 99		Arterial Connections (via Mercer Street)	
East SLU to NB SR 99		Arterial Connections	

Exhibit 5-11. Connections Provided To/From SR 99 – Aerial Alternative

	Good Access	Partial or Substandard Access	No Access
Stadium Area			
SB SR 99 to Stadium Area	SR 519 Interchange		
Stadium Area to SB SR 99	SR 519 Interchange		
NB SR 99 to Stadium Area	SR 519 Interchange		
Stadium Area to NB SR 99	SR 519 Interchange		
Downtown Seattle			
SB SR 99 to Downtown			None
Downtown to SB SR 99	Columbia Street Ramp		
NB SR 99 to Downtown	Seneca Street Ramp (Improved)		
Downtown to NB SR 99			None
Elliott and Western Corridor			
SB SR 99 to Elliott/Western			None (emergency only)
Elliott/Western to SB SR 99	Elliott Avenue Ramp		
NB SR 99 to Elliott/Western	Western Avenue Ramp		
Elliott/Western to NB SR 99			None (emergency only)
South Lake Union Area			
SB SR 99 to west SLU	Denny Way Ramp	Arterial Connections	
SB SR 99 to east SLU	Denny Way Ramp	Arterial Connections (via Mercer Street)	
West SLU to SB SR 99		Arterial Connections	
East SLU to SB SR 99		Arterial Connections (via Mercer Street)	
NB SR 99 to west SLU		Arterial Connections (via Mercer Street)	
NB SR 99 to east SLU		Arterial Connections	
West SLU to NB SR 99		Arterial Connections (via Mercer Street)	
East SLU to NB SR 99		Arterial Connections	

Exhibit 5-12. Connections Provided To/From SR 99 – Tunnel Alternative

	Good Access	Partial or Substandard Access	No Access
Stadium Area			
SB SR 99 to Stadium Area	SR 519 Interchange		
Stadium Area to SB SR 99	SR 519 Interchange		
NB SR 99 to Stadium Area	SR 519 Interchange		
Stadium Area to NB SR 99	SR 519 Interchange		
Downtown Seattle			
SB SR 99 to Downtown			None
Downtown to SB SR 99	King Street Ramp		
NB SR 99 to Downtown	King Street Ramp		
Downtown to NB SR 99			None
Elliott and Western Corridor			
SB SR 99 to Elliott/Western			None (emergency only)
Elliott/Western to SB SR 99	Alaskan Way Ramp		
NB SR 99 to Elliott/Western	Alaskan Way Ramp		
Elliott/Western to NB SR 99			None (emergency only)
South Lake Union Area			
SB SR 99 to west SLU	Denny Way Ramp	Arterial Connections	
SB SR 99 to east SLU	Denny Way Ramp	Arterial Connections (via Mercer or Thomas)	
West SLU to SB SR 99		Arterial Connections	
East SLU to SB SR 99		Arterial Connections (via Mercer or Thomas)	
NB SR 99 to west SLU		Arterial Connections (via Mercer or Thomas)	
NB SR 99 to east SLU		Arterial Connections	
West SLU to NB SR 99		Arterial Connections (via Mercer or Thomas)	
East SLU to NB SR 99		Arterial Connections	

Exhibit 5-13. Connections Provided To/From SR 99 – Bypass Tunnel Alternative

	Good Access	Partial or Substandard Access	No Access
Stadium Area			
SB SR 99 to Stadium Area	SR 519 Interchange		
Stadium Area to SB SR 99	SR 519 Interchange		
NB SR 99 to Stadium Area	SR 519 Interchange		
Stadium Area to NB SR 99	SR 519 Interchange		
Downtown Seattle			
SB SR 99 to Downtown			None
Downtown to SB SR 99	King Street Ramp		
NB SR 99 to Downtown	King Street Ramp		
Downtown to NB SR 99			None
Elliott and Western Corridor			
SB SR 99 to Elliott/Western			None (emergency only)
Elliott/Western to SB SR 99		Indirect via King Street Ramp and Alaskan Way	
NB SR 99 to Elliott/Western		Indirect via King Street Ramp and Alaskan Way	
Elliott/Western to NB SR 99			None (emergency only)
South Lake Union Area			
SB SR 99 to west SLU	Denny Way Ramp	Arterial Connections	
SB SR 99 to east SLU	Denny Way Ramp	Arterial Connections (via Mercer or Thomas)	
West SLU to SB SR 99		Arterial Connections	
East SLU to SB SR 99		Arterial Connections (via Mercer or Thomas)	
NB SR 99 to west SLU		Arterial Connections (via Mercer or Thomas)	
NB SR 99 to east SLU		Arterial Connections	
West SLU to NB SR 99		Arterial Connections (via Mercer or Thomas)	
East SLU to NB SR 99		Arterial Connections	

Exhibit 5-14. Connections Provided To/From SR 99 – Surface Alternative

	Good Access	Partial or Substandard Access	No Access
Stadium Area			
SB SR 99 to Stadium Area	SR 519 Interchange		
Stadium Area to SB SR 99	SR 519 Interchange		
NB SR 99 to Stadium Area	SR 519 Interchange		
Stadium Area to NB SR 99	SR 519 Interchange		
Downtown Seattle			
SB SR 99 to Downtown	Signalized Intersections		
Downtown to SB SR 99	Signalized Intersections		
NB SR 99 to Downtown	Signalized Intersections		
Downtown to NB SR 99	Signalized Intersections		
Elliott and Western Corridor			
SB SR 99 to Elliott/Western		Intersection at Alaskan Way (indirect)	
Elliott/Western to SB SR 99	Elliott Avenue Ramp		
NB SR 99 to Elliott/Western	Western Avenue Ramp		
Elliott/Western to NB SR 99		Intersection at Alaskan Way (indirect)	
South Lake Union Area			
SB SR 99 to west SLU	Denny Way Ramp	Arterial Connections	
SB SR 99 to east SLU	Denny Way Ramp	Arterial Connections (via Mercer or Thomas)	
West SLU to SB SR 99		Arterial Connections	
East SLU to SB SR 99		Arterial Connections (via Mercer or Thomas)	
NB SR 99 to west SLU		Arterial Connections (via Mercer or Thomas)	
NB SR 99 to east SLU		Arterial Connections	
West SLU to NB SR 99		Arterial Connections (via Mercer or Thomas)	
East SLU to NB SR 99		Arterial Connections	

To/From Stadium Area/SR 519

Under the 2030 Existing Facility scenario, SR 99 will have partial access in the stadium area, with an off-ramp from southbound SR 99 to southbound First Avenue S. and an on-ramp from northbound First Avenue to northbound SR 99. Because the existing ramps tie in directionally to First Avenue S., access to or from Pioneer Square requires circuitous travel. No access to southbound SR 99 or from northbound SR 99 is provided.

The Rebuild, Tunnel, Bypass Tunnel, and Surface Alternatives all include removal of the First Avenue S. ramps and replacement with a full aerial interchange at S. Royal Brougham Way and S. Atlantic Street. Under this configuration, access from southbound SR 99 and to northbound SR 99 will be maintained (though relocated from First Avenue S. to S. Royal Brougham Way), while additional access will be provided by an off-ramp from northbound SR 99 to S. Atlantic Street and an on-ramp from S. Atlantic Street to southbound SR 99. Two frontage roads connect the ramps at S. Royal Brougham Way and S. Atlantic Street, helping provide full access in all directions from these ramps.

The Aerial Alternative will use a different configuration in the stadium area. This configuration also will provide full access at S. Royal Brougham Way and S. Atlantic Streets, but will do so with the SR 99 mainline aerial and an interchange at ground level. Geometric constraints complicate this configuration, so some connections will not be provided as directly as under the configuration used for the other Build Alternatives. Specifically, southbound access onto SR 99 will be provided from S. Royal Brougham Way only, rather than from either S. Royal Brougham Way or S. Atlantic Street (via the frontage road) under the other Build Alternatives. Also, the northbound off-ramp will provide access to both S. Atlantic Street and S. Royal Brougham Way, but using a more constrained configuration. Still, the aerial configuration will provide full access in all directions in the stadium area. Note that because the connections under this configuration will occur at-grade, the BNSF tail track (see Section 4.6 for description) will interfere with traffic movements to and from E. Marginal Way and into the Port of Seattle's Terminal 46 facility.

To/From Downtown Seattle

Connections to and from downtown Seattle are provided under the 2030 Existing Facility scenario by an off-ramp from northbound SR 99 to Seneca Street and from Columbia Street to southbound SR 99. Both of these ramps provide access into the heart of downtown, but have geometric constraints relating to slow design speeds (under 25 mph) resulting from sharp turns as the ramps leave the mainline. Additionally, the southbound on-ramp from Columbia Street connects to the mainline with a short, left-side merge. These constraints somewhat limit the effectiveness of the connections provided, though in general, good access is provided to and from the south SR 99 corridor in downtown.

No access is provided downtown to northbound SR 99 or from southbound SR 99 under the 2030 Existing Facility scenario. Trips into or out of downtown that use the SR 99 corridor must access the facility at the Western Avenue ramps in Belltown or at the Denny ramps in the South Lake Union area. The Denny ramps (discussed under the South Lake Union Access section) also provide transit access to and from the north SR 99 corridor into and out of downtown.

The Rebuild and Aerial Alternatives will provide the same connections as the 2030 Existing Facility scenario, but with somewhat improved geometric conditions. This is especially true under the Aerial Alternative, where off-ramp turning radii will be improved, and a southbound add lane will replace the merge currently provided from Columbia Street. As with the 2030 Existing Facility scenario, no access will be provided to or from the north SR 99 corridor.

Under the Tunnel and Bypass Tunnel Alternatives, the ramps downtown will not be provided at their current locations. Instead, new ramps will be provided from northbound SR 99 to Alaskan Way, and from Alaskan Way to southbound SR 99 near S. King Street. Traffic access downtown will use an improved Alaskan Way (and Western Avenue northbound) to distribute to the grid in the downtown. The King Street ramps are less centrally located to downtown than the existing ramp locations, so trips destined to the central and northern portions of downtown will have to travel further on arterial streets to access the ramps. Trips in the south portions of downtown will find the King Street ramps closer to access, however. The King Street ramps also offer an advantage in that they distribute traffic to any number of streets (off of Alaskan Way) in downtown, rather than to or from a specific, single intersection. As with the 2030 Existing Facility, Rebuild, and Aerial Alternatives, direct access will not be provided between downtown and the north SR 99 corridor under the Tunnel or Bypass Tunnel Alternatives.

Access in the downtown area under the Surface Alternative will be provided at intersections on the SR 99 mainline. As with the Tunnel and Bypass Tunnel Alternatives, traffic could use a number of connecting arterials to distribute into or out of downtown. Also, the Surface Alternative is unique in that it will provide access to/from the north SR 99 corridor at the intersections on the mainline. As such, connectivity was rated as good for all directions of travel. Note, however, that the Surface Alternative will provide the connections through signalized intersection, and not limited access ramps.

To/From Belltown/Interbay

The 2030 Existing Facility scenario maintains the current ramps in the Belltown area, which provides a full range of connections to both directions of SR 99. The northbound off-ramp and southbound on-ramp are heavily used, and provide access not only to Belltown, but also to the Interbay, Magnolia, and Ballard areas north of downtown. These ramps also facilitate a large share of the freight movements that use SR 99.

The southbound off-ramp and northbound on-ramp are used less in comparison, providing local access to and from Belltown, and also indirect access to sections of downtown. Both of these ramps have geometric deficiencies, including short deceleration/acceleration sections and poor sight distances. Because of these deficiencies, coupled with modest use, these ramps will not be provided under any of the Build Alternatives (though these movements will be provided in a less direct manner under the Surface Alternative). Trips that currently use these ramps could instead access SR 99 at the Denny ramps. A small share of trips that access downtown via these ramps may instead choose to use the SR 519 ramps and circulate back into town on arterial streets.

The Aerial and Rebuild Alternatives will maintain the off-ramp from northbound SR 99 to Western Avenue and the on-ramp from Elliott Avenue to SR 99. Because the opposing off-ramp traffic from southbound SR 99 will be removed under all of the Build Alternatives, the northbound off-ramp is expected to operate more efficiently than under the existing configuration.

Under the Tunnel Alternative, access in the Belltown area will be relocated to Alaskan Way surface street. An off-ramp from northbound SR 99 and on-ramp to southbound SR 99 will connect to Alaskan Way north of Pike Street. Trips destined for Belltown will use connecting east–west streets, which will require at-grade crossings of the BNSF mainline tracks on the east side of Alaskan Way. Trips destined further north (Interbay, Ballard) will use the new Elliott to Alaskan Way Underpass (connecting Alaskan Way to Elliott Avenue), which is a separate planned project. Overall, connectivity in the Belltown area is considered similar to that provided under the Aerial and Rebuild Alternatives.

The Bypass Tunnel Alternative will not provide direct access in the Belltown area. Traffic northbound on SR 99 will instead use the Alaskan Way surface street through downtown to reach the Belltown area. Traffic destined for locations north of Belltown (Interbay or Ballard) could use the route on Alaskan Way surface street, or could travel further north on the corridor and access the arterial network north of the Battery Street Tunnel. Access in the southbound direction will be provided similarly. The configuration of

Alaskan Way surface street will include an additional lane in each direction through the downtown area to accommodate additional traffic under the Bypass Tunnel Alternative.

The Surface Alternative will provide access to both Alaskan Way surface street and Elliott/Western Avenues in the Belltown area at a new signalized intersection. This intersection also will allow access to northbound SR 99 and from southbound SR 99 at Alaskan Way.

To/From Mercer South Lake Union Area

Access in the South Lake Union area is accommodated much differently than on other segments under the 2030 Existing Facility scenario. Arterial connections directly to SR 99 provide partial access—right turn off and right turn on only—at several cross streets. Additionally, an on-ramp from Denny Way provides access to northbound SR 99, while off-ramps connect to Mercer Street northbound and Broad Street and Denny Way southbound. Though numerous access points are provided, connectivity in the area is limited by the lack of arterial connections across SR 99. Access to southbound SR 99 from points on the east side of the corridor is difficult, while access to and from the west side of the corridor is difficult from northbound SR 99.

Access under the Rebuild Alternative will remain unchanged from the 2030 Existing Facility.

Under the other Build Alternatives, a configuration that continues to rely on numerous arterial connections, but with improved connections across SR 99, will be implemented. Under this configuration, Mercer Street will be widened and reconfigured to provide two-way access under SR 99. An overpass at Thomas Street will provide additional access between the areas on either side of SR 99. Both of these features will improve the ability for traffic to reach points of access to or from the SR 99 corridor.

A trade-off associated with the arterial improvements is removal of the off-ramps to Mercer Street and Broad Street. The movements served by these two ramps will instead be accommodated by the numerous side street connections in the area. Access to northbound SR 99 and from southbound SR 99 at Denny Way will be unchanged.

Though the two schemes studied offer differing advantages and disadvantages, the overall connectivity in the South Lake Union area is similar across alternatives.

Design Options

Aerial Option

The Aerial Alternative could also be configured with an at-grade SR 519 with an elevated full access interchange. The connectivity assessment would not vary based on this option.

Tunnel Option

The Tunnel Alternative could be configured so that access to the Elliott/Western couplet, rather than to Alaskan Way, is provided in the Belltown area (similar to the access configuration for the Rebuild or Aerial Alternatives). The connectivity assessment would not vary based on this option.

Bypass Tunnel Option

The Bypass Tunnel Alternative could be configured so that access is provided from Alaskan Way surface street to the Elliott/Western couplet. This access would allow traffic to use Elliott Avenue and Western Avenue, rather than Alaskan Way, to access points northwest of the study area. The connectivity assessment would not vary based on this option.

5.3.2 Peak Hour Auto Travel Times

MOE H2: Corridor Peak Hour Travel Times

Key Findings

- The Rebuild, Aerial, and Tunnel Alternatives will provide the best overall travel times of the alternatives studied.
- Revised downtown access under the Tunnel and Bypass Tunnel Alternatives will result in travel times that are similar to those provided by the current ramp locations.
- The Surface Alternative is forecasted to result in longer travel times, particularly for trips that travel through (rather than to) the downtown area.
- The Bypass Tunnel Alternative is forecasted to provide competitive travel times for some routes, but longer travel times for others.

PM peak hour travel times for routes using the SR 99 corridor are presented as a measure of the alternatives' ability to efficiently provide mobility during periods of high use. Travel times are presented for the following routes, which were selected to represent the primary travel patterns experienced on the corridor:

Between the Aurora Bridge and Spokane Street

This route represents through trips (those not exiting SR 99 within the study area) on the corridor.

Between the Ballard Bridge and SR 519 (Stadium Area)

This route reflects the travel time differences trips to and from Ballard and Interbay will experience under each of the alternatives.

Between the Aurora Bridge and Downtown Seattle

Travel times between downtown Seattle and the north SR 99 corridor are measured by this route. Since no direct connection is provided to downtown, the route presumes use of the Denny Way ramps and surface arterials to access downtown (vicinity of Second Avenue and Madison Street).

Between Downtown Seattle and Spokane Street

Travel times between downtown Seattle (vicinity of Second Avenue and Madison Street) and the south SR 99 corridor are measured by this route.

Exhibit 5-15 summarizes corridor travel times by route and direction.

Exhibit 5-15. 2030 Corridor Travel Times

Southbound	2002 Existing	2030 Existing Facility	2030 Rebuild	2030 Aerial	2030 Tunnel	2030 Bypass Tunnel	2030 Surface
Aurora Bridge - Spokane Street	8	9	9	8	8	8	16
Ballard Bridge - SR 519 (Stadium Area)	12	13	14	14	14	21	22
Aurora Bridge - Seattle Downtown	15	16	16	16	16	16	19
Seattle Downtown - Spokane Street	8	9	9	9	10	10	10

Northbound	2002 Existing	2030 Existing Facility	2030 Rebuild	2030 Aerial	2030 Tunnel	2030 Bypass Tunnel	2030 Surface
Spokane Street - Aurora Bridge	9	12	9	9	9	13	33
SR 519 (Stadium Area) - Ballard Bridge	16	19	16	15	18	18	27
Seattle Downtown - Aurora Bridge	12	12	13	13	13	13	14
Spokane Street - Seattle Downtown	10	10	10	9	8	10	20

* Estimated travel times shown in minutes.

Aurora Bridge – Spokane Street

Travel times are estimated on SR 99 between the south end of the Aurora Bridge and the junction with the Spokane Street Viaduct/West Seattle Bridge. This route represents trips traveling through downtown on SR 99 between north Seattle and points south of downtown (e.g., Sea-Tac or West Seattle). Under the 2030 Existing Facility scenario, PM peak hour travel times are estimated at 9 minutes for southbound trips and 12 minutes for northbound trips. Congestion on northbound SR 99 near Seneca Street and Western Avenue contributes to the longer northbound travel time for through trips. Under the Rebuild, Aerial, and Tunnel Alternatives, travel times are forecasted to match or better (by one minute) those provided by the 2030 Existing Facility scenario southbound, while improving travel times northbound by 3 minutes. The improvement northbound is due largely to improved geometric conditions on the corridor through downtown and reduced congestion on the off-ramps provided to downtown.

The Bypass Tunnel Alternative is also forecasted to generally maintain travel times for through trips on SR 99 compared with the 2030 Existing Facility scenario. The travel time improvement seen northbound under the Rebuild, Aerial, and Bypass Tunnel Alternatives is not forecasted for the Bypass Tunnel Alternative, however. Congestion at the northbound on-ramp from S. Royal Brougham Way, as well as higher volumes through the Battery Street Tunnel, will lead to more delay than under the aforementioned Build Alternatives.

The Surface Alternative will experience through travel times that are considerably greater than under the 2030 Existing Facility scenario or the Build Alternatives. Southbound, travel times are estimated at 16 minutes (compared to 8 to 9 minutes for other alternatives). Northbound, congestion in downtown increases the through travel time to an estimated 33 minutes (compared to 9 to 13 minutes for other alternatives). The increased travel times under the Surface Alternative reflect both added delay caused by introducing signalized intersections to the corridor and reduced capacity provided relative to other alternatives.

Ballard Bridge – SR 519 (Stadium Area)

Travel times during the PM peak hour between the Ballard Bridge and the SR 519 area are estimated at 13 minutes southbound and 19 minutes northbound. Congestion at the Western Avenue off-ramp results in the longer northbound trip. Similar to conditions for through trips, the Rebuild, Aerial, and Tunnel Alternatives are forecasted to provide similar or improved travel times for this route compared to the 2030 Existing Facility scenario. In the northbound direction, the Rebuild and Aerial Alternatives are forecasted to save 3 to 4 minutes compared to the 2030 Existing Facility scenario due to improved operating conditions at the Western Avenue off-ramp. Improved ramp configuration, pedestrian crossings, and signal timings, coupled with removal of crossing traffic from the southbound off-ramp from SR 99 (which is currently provided, but will not be under the Build Alternatives), is forecasted to reduce congestion at this location. The Tunnel Alternative shows less improvement in the northbound direction, due to congestion forecasted on northbound Alaskan Way.

The Bypass Tunnel Alternative is forecasted to provide travel times competitive with the 2030 Existing Facility scenario in the northbound direction, even though a direct connection will not be provided in the Belltown area. This is due again to the congestion experienced at the Western Avenue off-ramp under 2030 Existing Facility conditions. In the southbound direction, the Bypass Tunnel Alternative is forecasted to result in increased travel times (21 minutes versus 14 minutes) compared to the 2030 Existing Facility, Rebuild, Aerial, or Tunnel Alternatives. Lack of a direct connection to SR 99 in Belltown, combined with traffic congestion on Alaskan Way during the PM peak hour, results in the longer travel time for this route in the southbound direction.

Travel times under the Surface Alternative are also forecasted to exceed those of the other alternatives for this route. Southbound, travel times are expected to average 22 minutes, similar to that forecasted for the Bypass Tunnel Alternative, but 7 minutes longer than forecasted for the other Build Alternatives. In the northbound direction, the average travel time for this route is estimated at 27 minutes, compared with 15 to 19 minutes for the other Build Alternatives or the 2030 Existing Facility scenario. As with the previous route evaluated, introduction of signalized intersections and reduction in corridor capacity downtown are responsible for the increased travel times.

Aurora Bridge – Downtown Seattle

Trips between downtown Seattle and the north SR 99 corridor do not use direct access in the downtown area. Instead, access is generally made at the Denny Way ramps. To evaluate travel time impacts for these trips, a route between central downtown (vicinity of Second Avenue and Madison Street) and the Aurora Bridge—using the Denny Way ramps—is assessed. Because the mainline sections of the corridor used for this route do not vary appreciably for this route, travel times are forecasted to vary only moderately by alternative. Southbound, travel times for the 2030 Existing Facility, Rebuild, Aerial, and Tunnel Alternatives are all estimated at 16 minutes. A slightly higher average travel time (17 minutes) is forecasted southbound for the Bypass Tunnel Alternative due to increased volumes on the mainline north of the Battery Street Tunnel. An average travel time of 19 minutes is forecasted under the Surface Alternative, due largely to increased congestion on other arterials downtown. Northbound, a 12-minute average travel time is forecasted for the 2030 Existing Facility scenario, while a slightly higher travel time of 13 minutes is estimated for the Rebuild, Aerial, Tunnel, and Bypass Tunnel Alternatives due to increased use of the northbound on-ramp at Denny Way that is expected with the closure of the northbound Western Avenue on-ramp. The Surface Alternative is forecasted to have a slightly higher average travel time (14 minutes), again due to increased congestion of the surface arterials.

Downtown Seattle – Spokane Street

Trips between downtown Seattle (vicinity of Second Avenue and Madison Street) and the south SR 99 corridor are accommodated in different ways by alternative, though generally travel times are expected to be similar. In the southbound direction, travel times are forecasted to average 8 minutes under the 2030 Existing Facility scenario, 9 minutes for the Rebuild and Aerial Alternatives, and 10 minutes for the Tunnel, Bypass Tunnel, and Surface Alternatives. In the northbound direction, travel times for this route are forecasted to average 10 minutes under the 2030 Existing Facility scenario. Under the Tunnel Alternative, travel times improve to 8 minutes for this route, due primarily to more direct access to the central and southern sections of downtown (rather than existing access further north at Seneca Street). Travel time for the Aerial Alternative is expected to average 9 minutes, while the Rebuild and Bypass Tunnel Alternatives will see average travel times of 10 minutes. The Surface Alternative will be subject to considerable congestion entering downtown, and an average travel time of 20 minutes is forecasted.

Except for the Surface Alternative entering downtown (northbound), travel times between downtown Seattle and the south SR 99 corridor are very similar across alternatives, even though the access locations vary considerably.

Design Options

Tunnel Option

The Tunnel Alternative could be configured with the addition of ramps at Elliott and Western, rather than to Alaskan Way. This option would result in improved travel times northbound for the Ballard Bridge – SR 519 route, as less congestion on the Elliott/Western couplet is forecasted than on the northern segments of Alaskan Way under Tunnel Alternative volumes. Travel times would be similar to those reported under the Rebuild or Aerial

Alternatives (2 to 3 minutes faster) for the Ballard Bridge – SR 519 route with the Tunnel With Ramps at Elliott and Western Avenues Option.

Bypass Tunnel Option

The Bypass Tunnel Alternative could also be configured with the addition of an arterial connection from Alaskan Way to Elliott Avenue and Western Avenue. This option might result in somewhat improved travel times northbound for the Ballard Bridge – SR 519 route, though any improvement would likely be small since corridor delay on segments of Alaskan Way south of Pike Street would still be encountered.

5.3.3 Vehicle Throughput

MOE H3: SR 99 Corridor PM Peak Hour Vehicle Throughput

Key Findings

- Vehicle throughput through the corridor is similar across alternatives, except for the Surface Alternative, under which fewer vehicles will be accommodated due to corridor capacity constraints.
- More vehicles use the south corridor under all Build Alternatives (except the Surface Alternative) than under the 2030 Existing Facility scenario, due to the access added to and from SR 519.

This section compares vehicle throughput during PM peak hour conditions, both northbound and southbound, for all alternatives for the primary segments of the corridor. Vehicle throughput is a measure of the number of vehicles using specific segments of the corridor. Results are shown in Exhibit 5-16.

Exhibit 5-16. 2030 PM Peak Hour Vehicle Throughput on SR 99

	2002 Existing	2030 Existing Facility	2030 Rebuild	2030 Aerial	2030 Tunnel	2030 Bypass Tunnel	2030 Surface
North Corridor	7,500	9,700	9,700	9,600	9,800	9,700	7,600
Battery Street Tunnel	5,700	7,500	7,000	7,300	7,600	8,200	3,200
North Downtown	7,400	9,400	9,600	9,800	9,100	8,200	5,900
South Downtown	9,300	11,400	11,600	11,800	11,900	11,500	6,500
South Corridor	7,400	9,200	9,900	10,000	9,900	9,700	8,300

Overall, forecasted vehicle throughput for all alternatives is similar, with the exception of the Surface Alternative. Traffic volumes are anticipated to be much lower for the Surface Alternative due to capacity constraints downtown that limit through trips. The traffic carried by the SR 99 corridor under the

Surface Alternative will be from 10 to more than 50 percent lower than for the corresponding segments under the 2030 Existing Facility.

There is some vehicle throughput variation in the Battery Street Tunnel section. The Bypass Tunnel Alternative results in a higher vehicle throughput (9 percent higher, compared to the 2030 Existing Facility) since some trips destined for Interbay, Belltown, and lower Queen Anne access SR 99 in South Lake Union (since this alternative does not have ramps at Elliott/Western). Vehicle throughput is very low (57 percent lower than the 2030 Existing Facility) for the Surface Alternative due to a large decrease in through trips, and local trips avoiding the central downtown section of the corridor.

Some variation in vehicle throughput also occurs in the north downtown segment. Vehicle throughput on the SR 99 corridor will be about 13 percent lower for the Bypass Tunnel Alternative since there will be no ramps at Elliott/Western.

For the south downtown and south corridor segments, vehicle throughput is expected to be slightly higher for the Rebuild, Aerial, and Tunnel Alternatives. For these alternatives, vehicle throughput in the south downtown and south corridor segments will be 2 to 9 percent higher than for the 2030 Existing Facility scenario. Note that the south downtown segment includes mainline volumes south of the downtown ramps (Seneca/Columbia or King Street for the Tunnel and Bypass Tunnel Alternatives, or at Madison Street for the Surface Alternative).

5.3.4 Person Throughput

MOE H4: SR 99 Corridor PM Peak Hour Person Throughput

Key Findings

- Person throughput entering and exiting the corridor in the north will be similar across alternatives, except for the Surface Alternative, under which considerably fewer people will be moved through the corridor.
- More people will be moved through the south corridor under all Build Alternatives (except the Surface Alternative) than under the 2030 Existing Facility scenario, due to the access added to and from SR 519.
- Forecasted transit ridership in the corridor does not vary greatly, so results mirror the vehicle throughput results.

Overall, person throughput for all alternatives, with the exception of the Surface Alternative, is similar for most segments (results are shown in Exhibit 5-17). The results generally mirror vehicle throughput findings described in the previous section. Again, person throughput for the Surface Alternative is much lower (10 to 58 percent, depending on the segment) than under the 2030 Existing Facility scenario.

Exhibit 5-17. 2030 PM Peak Hour Person Throughput on SR 99

	2002 Existing	2030 Existing Facility	2030 Rebuild	2030 Aerial	2030 Tunnel	2030 Bypass Tunnel	2030 Surface
North Corridor	11,800	16,800	16,900	16,600	16,900	16,800	13,900
Battery Street Tunnel	7,500	10,000	9,300	9,700	10,100	10,900	4,200
North Downtown	9,900	12,500	12,800	13,000	12,100	10,900	7,800
South Downtown	14,900	17,100	17,400	17,600	15,900	15,300	8,600
South Corridor	12,400	14,100	15,000	15,200	14,800	14,500	12,700

The variation in person throughput in the Battery Street Tunnel, north downtown, and south corridor segments are due to the variation in vehicle throughput in these segments, as described above.

For the south downtown segment, some person throughput variation cannot be explained by variation in vehicle throughput. Compared to the 2030 Existing Facility scenario, person throughput is 7 percent lower for the Tunnel Alternative and almost 11 percent lower for the Bypass Tunnel Alternative in the south segment. For these alternatives, as well as the Surface Alternative, transit is assumed to accesses downtown via S. Royal Brougham Way and the S. Atlantic Street ramps. For the 2030 Existing Facility, Aerial, and Rebuild Alternatives, transit was assumed to access downtown at Seneca Street (for northbound off) or Columbia (for southbound on). These different transit access points explain why person throughput varies to a larger degree than vehicle throughput for the south segment. It should be noted that transit routing could still be accommodated downtown under the Tunnel, Bypass Tunnel, and Surface Alternatives, but King County Metro staff have indicated that they would likely route transit services on SR 519 and Fourth Avenue S. under those alternatives. Similarly, the Rebuild and Aerial Alternatives could also use the SR 519/Fourth Avenue S. routing if the transit agencies found it preferable. Therefore, the greater variation in person throughout than vehicle throughput in the south segment is primarily dependent on transit routing decisions.

5.3.5 SR 99 Demand and Capacity

MOE H5: Corridor Peak Hour Volume to Capacity Estimates

Key Findings

- Under all alternatives except the Surface Alternative, the Battery Street Tunnel will operate near or over capacity.
- The Surface Alternative is expected to operate at highly over capacity conditions in downtown Seattle.
- Over the course of a typical weekday, the Surface Alternative is forecasted to operate under congested conditions for 9 hours. The Bypass Tunnel Alternative would operate under congested conditions for 5 hours. The Rebuild, Aerial, and Tunnel Alternatives would all operate under congested conditions for less than 4 hours per day, similar to or better than the 2030 Existing Facility conditions.

This section compares volume to capacity (V/C) for each of the alternatives for the five primary segments of the SR 99 mainline. This measure is expressed as a percentage and represents the share of corridor capacity used by the projected PM peak hour traffic volumes, by segment. Under all Build Alternatives except for the Surface Alternative, the SR 99 mainline is a limited access facility through downtown. Under the Surface Alternative, the mainline between King Street and Pike Street is an at-grade arterial roadway. Information regarding performance of other surface roadways is presented in Section 5.3.8.

The procedures and assumptions used in estimating V/C percentages are detailed in Chapter 2, Methodology.

Southbound PM Peak Hour Volume/Capacity Estimates

In the north corridor segment, all of the alternatives are forecasted to exhibit similar V/C percentages of 74 to 78 percent, except the Surface Alternative, which has a much lower forecasted V/C of 51 percent (results are shown in Exhibit 5-18). The V/C for the Surface Alternative is lower as a result of lower traffic volumes due to capacity constraints further south. In any case, all of the V/C percentages in the north corridor are within capacity.

Exhibit 5-18. 2030 PM Peak Hour Volume/Capacity – Southbound SR 99

	2002 Existing	2030 Existing Facility	2030 Rebuild	2030 Aerial	2030 Tunnel	2030 Bypass Tunnel	2030 Surface
North Corridor	56%	74%	75%	74%	75%	78%	51%
Battery Street Tunnel	65%	91%	87%	92%	95%	114%	30%
North Downtown	56%	71%	70%	67%	67%	89%	135%
South Downtown	76%	92%	90%	65%	70%	70%	127%
South Corridor	59%	72%	75%	76%	75%	75%	62%

In the Battery Street Tunnel segment, the 2030 Existing Facility, Rebuild, Aerial, and Tunnel Alternatives will all operate near capacity, with forecasted V/Cs of 87 to 95 percent. The Bypass Tunnel Alternative will operate over capacity, at a V/C of 114 percent. The Bypass Tunnel Alternative will operate over capacity in this segment because the absence of on-ramps at Western/Elliott will result in additional trips accessing the corridor north of the Battery Street Tunnel, and continuing south from there. In contrast, traffic under the Surface Alternative will be greatly reduced, since capacity constraints further south will limit the volume that would use this segment. The result is that the Battery Street Tunnel will operate well under capacity under the Surface Alternative.

In the north downtown segment, the 2030 Existing Facility, Rebuild, Aerial, and Tunnel Alternatives all operate well within capacity, with V/Cs of 67 to 71 percent. The Bypass Tunnel Alternative operates near capacity, at a V/C of 89 percent, since only two lanes are provided. The Surface Alternative operates considerably over capacity, with a V/C of 135 percent in the waterfront area. The V/C for the Surface Alternative is much higher in this segment because of the relatively low capacity provided by its arterial segments.

In the south downtown segment, the 2030 Existing Facility and Rebuild Alternatives are approaching capacity, with V/C percentages of 92 percent and 90 percent, respectively. The 2030 Existing Facility scenario is approaching capacity because only three southbound lanes are provided, and the capacity estimated per lane is lower than for other alternatives due to narrow lane widths and shoulders. The Rebuild Alternative is also approaching capacity in the south downtown segment due to the presence of only three southbound lanes. The Aerial, Tunnel, and Bypass Tunnel Alternatives operate within capacity, with V/Cs of 65 to 70 percent. The Surface Alternative operates considerably over capacity, with a V/C of 127 percent, again due to the relatively low capacity provided by its arterial segments.

In the south corridor segment, all alternatives operate at acceptable V/C levels of 62 to 76 percent.

Overall, the Rebuild, Aerial, and Tunnel Alternatives are forecasted to operate at favorable V/C levels for southbound segments. However, all alternatives, except the Surface Alternative, operate near or over capacity in the Battery Street Tunnel segment. The Bypass Tunnel Alternative operates over capacity in the Battery Street Tunnel, and near capacity in the north downtown segment. The Surface Alternative operates considerably over capacity in the two downtown segments due to lower lane capacity in those sections. Finally, the 2030 Existing Facility and Rebuild Alternatives operate near capacity in the south downtown segment.

Northbound PM Peak Hour Volume/Capacity Estimates

In the north corridor segment, all of the alternatives are near capacity with V/C levels of 93 to 96 percent, except for the Surface Alternative, which has a much lower V/C of 82 percent since much fewer vehicles can access this segment of the corridor due to capacity constraints further south. The high V/C rates for the other alternatives are due to high northbound PM peak hour volumes using the facility as commuters exit the downtown area. Results are shown in Exhibit 5-19.

In the Battery Street Tunnel segment, the 2030 Existing Facility, Rebuild, Aerial, Tunnel, and Bypass Tunnel Alternatives all operate near or over capacity, with V/C ratios of 97 to 111 percent. The Surface Alternative does not operate near capacity since constraints further south limit the volume that can utilize this segment.

In the north downtown segment, the 2030 Existing Facility, Rebuild, Aerial, and Tunnel Alternatives all operate within capacity, with V/C levels of 74 to 79 percent. The Bypass Tunnel Alternative operates near capacity, at a V/C of 91 percent, since only two lanes are provided. The Surface Alternative operates over capacity, with a V/C of 131 percent in the waterfront area. As in the southbound direction, the V/C levels for the Surface Alternative are much higher in this segment due to the capacity constraints of the arterial segments. Similarly, in the south downtown segment, all alternatives operate at acceptable V/C ratios of 57 to 66 percent, except the Surface Alternative, which has a V/C of 130 percent.

In the south corridor segment, all alternatives operate at acceptable V/C percentages of 59 to 68 percent.

Overall, all alternatives, except the Surface Alternative, operate near or over capacity in the Battery Street Tunnel and north corridor segments. The Bypass Tunnel Alternative also operates near capacity in the north downtown segment. These alternatives operate at good V/C levels in the three segments south of the Battery Street Tunnel. However, the Surface Alternative is forecasted to operate well over capacity in the two downtown segments due to lower lane capacity in those sections.

Exhibit 5-19. 2030 PM Peak Hour Volume/Capacity – Northbound SR 99

	2002 Existing	2030 Existing Facility	2030 Rebuild	2030 Aerial	2030 Tunnel	2030 Bypass Tunnel	2030 Surface
North Corridor	75%	96%	96%	95%	96%	93%	82%
Battery Street Tunnel	76%	107%	97%	100%	105%	111%	50%
North Downtown	61%	78%	76%	74%	79%	91%	131%
South Downtown	54%	66%	64%	63%	59%	57%	130%
South Corridor	48%	60%	68%	68%	68%	68%	59%

MOE H6. Corridor Hours of Congested Conditions

Exhibit 5-20 shows the number of hours each day that congested conditions are forecasted for the SR 99 mainline. The duration of congestion was estimated by identifying the number of hours per day the busiest segment of SR 99 would operate near or at capacity (over 90% of estimated capacity). During these times, heavy traffic volumes and slower speeds would be expected. Similar to conditions for the 2030 Existing Facility, congested conditions are forecast for three to four hours per day under the Rebuild, Aerial, and Tunnel Alternatives, with congestion generally forming in the vicinity of the Battery Street Tunnel. For the Bypass Tunnel Alternative, congestion would generally form around the Battery Street Tunnel and at the northbound merge from SR 519, and last approximately 5 hours per day. In the case of the Surface Alternative, the source of congestion would be the downtown surface street segment, which would operate at congested levels for 9 hours during a typical weekday.

Exhibit 5-20. Daily Hours of Congested Operations on SR 99 Mainline

	2002 Existing	2030 Existing Facility	2030 Rebuild	2030 Aerial	2030 Tunnel	2030 Bypass Tunnel	2030 Surface
Southbound	< 1	3	3	3	3	5	9
Northbound	< 1	4	4	4	4	5	9

5.3.6 AWV Segment LOS and Speeds

MOE H7: SR 99 Mainline Levels of Service and Speeds

Key Findings

- The Aerial and Tunnel Alternatives will outperform other alternatives in terms of LOS and segment speed.
- All alternatives, except the Surface Alternative, are forecasted to operate at LOS F northbound in the Battery Street Tunnel.
- In the northbound direction, the Bypass Tunnel and Surface Alternatives are forecasted to operate at LOS F conditions through the downtown area. Average speeds under these alternatives, particularly the Surface Alternative, are forecasted to be lower than under other alternatives during the PM peak hour northbound. Average speeds under the Surface Alternative will be lower still, particularly northbound through downtown.

This section presents PM peak hour LOS and average travel speeds for corridor segments under the 2030 Existing Facility scenario and each of the Build Alternatives. Although LOS can provide an indication of how a facility is performing overall, it is not, by itself, a good measure to use to compare between alternatives in this project since corresponding segments do not always use the same facility type, and LOS standards vary by facility type. For example, for the central segment, the facility type for the Surface Alternative (signalized urban street) is different than that for the other alternatives (limited access highway) and has a different set of LOS criteria. As such, the Surface Alternative could exhibit a better LOS than one of the limited access highway plans, but have much lower speeds and vehicle throughput. Therefore, the LOS presented should be viewed as a measure of how this portion of the facility is forecasted to operate relative to its facility type. To better help gauge performance across facility types, peak hour travel speeds are also presented.

Southbound PM Peak Hour LOS and Speed

Southbound SR 99 mainline PM peak hour forecasted LOS and speeds, by segment, are presented in Exhibit 5-21 and Exhibit 5-22, respectively.

Exhibit 5-21. SR 99 PM Peak Hour Segment LOS – Southbound

<table>
<tr><th>Southbound</th><th>2002 Existing</th><th>2030 Existing Facility</th><th>2030 Rebuild</th><th>2030 Aerial</th><th>2030 Tunnel</th><th>2030 Bypass Tunnel</th><th>2030 Surface</th></tr>
<tr><td colspan="8">North Corridor</td></tr>
<tr><td>North of Battery Street Tunnel</td><td>A</td><td>B</td><td>B</td><td>A</td><td>A</td><td>B</td><td>B</td></tr>
<tr><td colspan="8">Battery Street Tunnel</td></tr>
<tr><td>Battery Street Tunnel</td><td>E</td><td>F</td><td rowspan="2">E</td><td rowspan="2">E</td><td rowspan="2">E</td><td rowspan="2">F</td><td rowspan="2">C</td></tr>
<tr><td>Western Off to Elliott/Alaskan On</td><td>D</td><td>E</td></tr>
<tr><td colspan="8">Midtown</td></tr>
<tr><td>Elliott/Alaskan On to Columbia On</td><td>D</td><td>D</td><td>D</td><td>D</td><td rowspan="2">D</td><td rowspan="2">E</td><td rowspan="2">D*</td></tr>
<tr><td>Columbia On to First Avenue/SR 519 Off</td><td>E</td><td>F</td><td>F</td><td>D</td></tr>
<tr><td colspan="8">South Corridor</td></tr>
<tr><td>SR 519 Off to King Street On</td><td rowspan="3">D</td><td rowspan="3">E</td><td rowspan="2">E</td><td rowspan="2">D</td><td>D</td><td>D</td><td rowspan="2">F</td></tr>
<tr><td>King Street On to SR 519 On</td><td>D</td><td>D</td></tr>
<tr><td>SR 519 On to Spokane Street</td><td>E</td><td>D</td><td>D</td><td>D</td><td>D</td></tr>
</table>

* LOS for arterial segments is based on different criteria than LOS for limited access facilities. Therefore, the Surface Alternative LOS in the midtown is not directly comparable to LOS for other alternatives.

Exhibit 5-22. SR 99 PM Peak Hour Segment Speeds – Southbound

	2002 Existing	2030 Existing Facility	2030 Rebuild	2030 Aerial	2030 Tunnel	2030 Bypass Tunnel	2030 Surface
North Corridor	39	33	34	37	36	30	31
Battery Street Tunnel	34	29	32	37	39	31	29
Midtown	41	40	43	50	50	49	15
South Corridor	44	44	44	47	47	47	36

Under the 2030 Existing Facility scenario, two areas are forecasted to operate at a failing LOS F: the Battery Street Tunnel and the midtown area between Columbia Street and First Avenue S. The Battery Street Tunnel is forecasted to operate at LOS F with a speed of 29 mph due to high volumes and reduced capacity. The midtown area near Columbia and First Avenue is forecasted to operate at LOS F and at a speed of 40 mph because only three lanes are provided in this section, and volumes are high once traffic from the Columbia Street on-ramp joins the mainline.

In the Rebuild Alternative, the midtown area near Columbia Street and First Avenue is forecasted to operate at LOS F (at a speed of 43 mph) due to high volumes and reduced capacity since there will be only three lanes in this section. The Battery Street Tunnel and the south corridor areas are forecasted to operate at very congested conditions of LOS E. The Battery Street Tunnel segment is forecasted to operate at LOS E (with a speed of 32 mph) due to high volumes and reduced capacity (two lanes each direction), though removal of the southbound on-ramp at Western Avenue will improve operations slightly relative to the 2030 Existing Facility scenario. The south corridor area is forecasted to operate at LOS E with a speed of 44 mph due to high volumes.

In the Aerial Alternative, the Battery Street Tunnel is forecasted to operate at LOS E and an average speed of 37 mph due to high volumes and limited capacity. The midtown area near Columbia Street and First Avenue is forecasted to operate at LOS D and 50 mph, better than the 2030 Existing Facility scenario due to provision of a fourth lane for traffic added at Columbia Street.

The Tunnel Alternative will be similar to the Aerial Alternative in that it is forecasted to operate at a favorable LOS everywhere except the Battery Street Tunnel, where it is forecasted to operates at LOS E with a speed of 39 mph.

The Bypass Tunnel Alternative is forecasted to operate at LOS F and a speed of 31 mph in the Battery Street Tunnel and to operate under congested conditions (LOS E and a speed of 49 mph) in the midtown area. This congestion in the midtown area may be attributed to the existence of only two southbound lanes and relatively high traffic volumes.

In the southbound direction, the Surface Alternative is forecasted to operate at favorable LOS everywhere except the stadium area. The stadium area (S. Royal Brougham Way to S. Atlantic Street) is forecasted to operate at LOS F (with a speed of 31 mph) due to the high mainline volumes and high levels of merging traffic.

Although the Surface Alternative is forecasted to operate at a fairly high LOS southbound through the midtown area, its performance cannot be characterized as similar to the other Build Alternatives. Arterial LOS is measured on a different scale than LOS for limited access facilities, so the segment LOS for the Surface Alternative in midtown is not directly comparable to those for the other alternatives. In this case, the Surface Alternative is forecasted to operate at LOS D, but the average vehicle speed is

15 mph. In comparison, the Bypass Tunnel Alternative operates at LOS E (for a limited access facility), even though its average speed is 49 mph.

Northbound PM Peak Hour LOS and Speed

Northbound PM peak hour forecasted LOS and speeds are presented in Exhibit 5-23 and Exhibit 5-24, respectively.

Exhibit 5-23. SR 99 PM Peak Segment LOS – Northbound

<table>
<tr><th>Northbound</th><th>2002 Existing</th><th>2030 Existing Facility</th><th>2030 Rebuild</th><th>2030 Aerial</th><th>2030 Tunnel</th><th>2030 Bypass Tunnel</th><th>2030 Surface</th></tr>
<tr><td colspan="8">North Corridor</td></tr>
<tr><td>North of Battery Street Tunnel</td><td>B</td><td>C</td><td>B</td><td>C</td><td>C</td><td>C</td><td>C</td></tr>
<tr><td colspan="8">Battery Street Tunnel</td></tr>
<tr><td>Battery Street Tunnel</td><td>F</td><td>F</td><td rowspan="2">F</td><td rowspan="2">F</td><td rowspan="2">F</td><td rowspan="2">F</td><td rowspan="2">C</td></tr>
<tr><td>Western Off to Elliott/Alaskan On</td><td>E</td><td>F</td></tr>
<tr><td colspan="8">Midtown</td></tr>
<tr><td>Elliott/Alaskan On to Columbia On</td><td>E</td><td>F</td><td>E</td><td>D</td><td rowspan="2">E</td><td rowspan="2">F</td><td rowspan="2">F*</td></tr>
<tr><td>Columbia On to First Avenue/SR 519 Off</td><td>D</td><td>F</td><td>D</td><td>D</td></tr>
<tr><td colspan="8">South Corridor</td></tr>
<tr><td>SR 519 Off to King Street On</td><td rowspan="3">C</td><td rowspan="3">D</td><td rowspan="2">D</td><td rowspan="2">C</td><td>C</td><td>F</td><td rowspan="2">F</td></tr>
<tr><td>King Street On to SR 519 On</td><td>C</td><td>F</td></tr>
<tr><td>SR 519 On to Spokane Street</td><td>D</td><td>D</td><td>D</td><td>F</td><td>F</td></tr>
</table>

* LOS for arterial segments is based on different criteria than LOS for limited access facilities. Therefore, the Surface Alternative LOS in the midtown is not directly comparable to LOS for other alternatives.

Exhibit 5-24. SR 99 PM Peak Segment Speeds – Northbound

	2002 Existing	2030 Existing Facility	2030 Rebuild	2030 Aerial	2030 Tunnel	2030 Bypass Tunnel	2030 Surface
North Corridor	33	27	30	28	26	25	26
Battery Street Tunnel	33	25	33	36	33	26	28
Midtown	39	27	46	50	46	32	8
South Corridor	46	46	47	49	49	27	10

In the 2030 Existing Facility scenario, traffic operations are expected to be highly congested (LOS F) from the midtown area north. Speeds in these areas range from 25 to 27 mph. Much of the operational impact is due to severe congestion and queuing at the Western off-ramp, coupled with interference from traffic entering the mainline at the Battery Street ramp immediately prior to the entrance to the Battery Street Tunnel.

In the Rebuild Alternative, speeds are forecasted to be higher in the Battery Street Tunnel area (33 mph versus 25 mph for the 2030 Existing Facility scenario). Although the Battery Street Tunnel area is still forecasted to operate at LOS F, the improvement in operations at the Western Avenue off-ramp and tunnel entrance (due to removal of the Battery Street on-ramp) will reduce the upstream impact to the mainline so that the midtown area is forecasted to operate at LOS D/E (compared to F for the 2030 Existing Facility).

The Aerial Alternative is forecasted to operate similarly to the Rebuild Alternative. Operations are forecasted to be poor (LOS F and a speed of 36 mph) in the Battery Street Tunnel area, but improved for other segments.

The Tunnel Alternative is forecasted to operate at LOS F (and at a speed of 33 mph) in the Battery Street Tunnel, and at LOS E (46 mph) in the midtown area.

The Bypass Tunnel Alternative is forecasted to operate under congested conditions (LOS F) during the PM peak hour throughout most of the corridor. Performance in the midtown area is forecasted to be comparable to that under the 2030 Existing Facility scenario, as high volumes through the Battery Street Tunnel will affect northbound operations. In the south corridor, merge conflicts at the Royal Brougham on-ramp (where heavy on-ramp volumes merge with two mainline lanes as they enter the tunnel) are expected to limit speeds to an average of 27 mph.

The Surface Alternative is forecasted to be very congested (LOS F and speeds ranging from 8 to 10 mph) from the stadium area through midtown areas. The Battery Street Tunnel, however, is not forecasted to be congested (LOS C with a speed of 28 mph) due to the capacity constraints upstream, which will limit vehicle throughput on the corridor.

5.3.7 Distribution of Traffic

MOE H8: Traffic Distribution

Key Findings

- The Aerial, Tunnel, Bypass Tunnel, and Surface Alternatives all will increase trips on surface arterials entering the study area to the north, possibly due to the decreased connectivity provided off of the SR 99 corridor in South Lake Union under the configuration presumed north of Battery Street Tunnel under those alternatives.

- The Surface Alternative is forecasted to cause increased traffic on arterials (+16 percent) and I-5 (+6 percent) through downtown Seattle. Other alternatives are forecasted to decrease.
- The Build Alternatives all will shift trips from the surface arterials to SR 99 in the south corridor due to added access at SR 519. As shown previously in Exhibits 5-18 and 5-19, this segment of SR 99 has sufficient capacity to accommodate the added traffic.
- The Surface Alternative is forecasted to decrease the north–south trips into or through downtown relative to the 2030 Existing Facility or Build Alternatives due to the reduction in total capacity provided. Instead, corresponding increases in trips to locations outside of, or not requiring a trip through, downtown were forecasted.

This section provides an assessment of the expected changes in daily traffic volumes and general traffic patterns for each of the alternatives, measured at three common locations on parallel transportation facilities (screenlines):

- A north screenline located near Roy Street representing traffic entering and exiting the study area to the north.
- A central screenline near Madison Street representing typical traffic distribution in the center of the study area.
- A south screenline north of Spokane Street representing traffic entering and exiting the study area to the south.

These screenlines allow major trends or shifts in traffic patterns to be identified for the locations identified. Daily traffic volumes for all streets and highways between Elliott Bay and I-5 are summed and grouped by facility type:

- North–south arterials and local streets (excluding Alaskan Way)
- Alaskan Way
- SR 99
- I-5

In addition, impacts to total 2030 daily traffic are presented. Results are summarized in Exhibit 5-25.

Exhibit 5-25. Daily Traffic Distributions

	2002 Existing	2030 Existing Facility	Rebuild	Aerial	Tunnel	Bypass Tunnel	Surface
North–South Arterials (Except Alaskan Way)							
North (Roy Street)	133,000	167,000	168,000	170,000	173,000	170,000	172,000
			1%	*2%*	*4%*	*2%*	*3%*
Downtown (Marion Street)	79,000	79,000	76,000	75,000	72,000	67,000	92,000
			(4%)	*(5%)*	*(9%)*	*(13%)*	*16%*
South (Spokane Street)	151,000	198,000	190,000	188,000	188,000	188,000	185,000
			(4%)	*(5%)*	*(5%)*	*(5%)*	*(7%)*
I-5							
North (Roy Street)	322,000	386,000	386,000	389,000	388,000	389,000	393,000
			0%	*1%*	*1%*	*1%*	*2%*
Downtown (Marion Street)	288,000	368,000	365,000	367,000	367,000	371,000	390,000
			(1%)	*(0%)*	*(0%)*	*1%*	*6%*
South (Spokane Street)	271,000	335,000	335,000	334,000	337,000	337,000	341,000
			0%	*(0%)*	*1%*	*1%*	*2%*
Alaskan Way							
North (Roy Street)	N/A	N/A					
Downtown (Marion Street)	9,000	11,000	10,000	10,000	21,000	48,000	74,000
			(9%)	*(9%)*	*91%*	*336%*	*576%*
South (Spokane Street)	N/A	N/A					
SR 99							
North (Roy Street)	61,000	85,000	85,000	81,000	83,000	85,000	65,000
			0%	(5%)	(2%)	0%	(24%)
Downtown (Marion Street)	103,000	126,000	133,000	129,000	122,000	90,000	(see Alaskan Way)
			6%	*2%*	*(3%)*	*(29%)*	
South (Spokane Street)	86,000	108,000	114,000	118,000	115,000	115,000	103,000
			6%	*9%*	*6%*	*6%*	*(5%)*
Total Volumes							
North (Roy Street)	516,000	638,000	639,000	640,000	645,000	644,000	630,000
			0%	0%	1%	1%	(1%)
Downtown (Marion Street)	479,000	584,000	584,000	581,000	582,000	578,000	556,000
			0%	(1%)	(0%)	(1%)	(5%)
South (Spokane Street)	508,000	641,000	639,000	640,000	640,000	640,000	628,000
			(0%)	(0%)	(0%)	(0%)	(2%)

North Screenline

This screenline, running east–west in the vicinity of Roy Street, captures travel patterns as traffic enters and exits the project study area to the north.

While the traffic patterns of the Rebuild Alternative will be largely unchanged from those under the 2030 Existing Facility scenario, all other alternatives will exhibit some shift of traffic off of the SR 99 corridor to parallel arterials and I-5. The impact to I-5 will generally be small (2 percent increase under the Surface Alternative, 1 percent under the other Build Alternatives), though larger increases will be seen on the parallel arterials. Increases of 2 percent under the Aerial and Bypass Tunnel Alternatives, 3 percent under the Surface Alternative, and 4 percent under the Tunnel Alternative are forecasted. Under the Tunnel and Bypass Tunnel Alternatives (and to a lesser degree the Aerial Alternative), overall screenline volumes are also forecasted to increase by about 1 percent, so traffic increases on the facilities parallel to SR 99 will not be due solely to traffic shifting from SR 99.

These shifts may be attributable to the plan configurations in the South Lake Union area. While arterial connectivity will increase in the South Lake Union area under these alternatives, the quality of connections off of SR 99 will decrease with the removal of the off-ramps to Mercer Street and Broad Street. The improved arterial access to SR 99 could draw more vehicles on arterials into the South Lake Union area to access the corridor, since access under the 2030 Existing Facility scenario will be fairly poor. At the same time, some vehicles may take alternate routes rather than SR 99 to access the South Lake Union area, since off-ramp connectivity will be decreased.

The Surface Alternative is expected to accommodate fewer total daily trips across all facilities at the north screenline. This result reflects the decreased capacity further south through the central corridor, and indicates that accessibility to downtown will decrease under the Surface Alternative. The AWV model did not predict any noteworthy mode shift to non-automobile modes under the Surface Alternative (see Section 5.2.1). Review of zone-to-zone travel patterns shows that the same number of automobile trips is predicted under the Surface Alternative, but fewer of these trips travel to or through the study area, instead redistributing to areas outside of the study area.

Downtown Screenline

The downtown screenline runs perpendicular to SR 99 in the vicinity of Madison Street and crosses Alaskan Way, SR 99, all arterials downtown, and I-5. This screenline captures traffic distribution changes resulting from the alternatives in the center of downtown Seattle.

Total screenline volumes in the downtown vary slightly relative to the 2030 Existing Facility scenario under the Rebuild, Aerial, Tunnel and Bypass Tunnel Alternatives (1 percent or less), but more substantially under the Surface Alternative (-4 percent). This reduction in overall screenline volumes under the Surface Alternative is reflective of capacity reductions on the SR 99 corridor and limited capacity elsewhere in the downtown area to accommodate displaced demand for that alternative.

A 6 percent increase in daily traffic on I-5 is forecasted under the Surface Alternative, relative to the 2030 Existing Facility scenario. Other Build Alternatives are not forecasted to have an impact to I-5 in the downtown area, with the Rebuild, Aerial, and Tunnel Alternatives all showing slight decreases to I-5 traffic (1 percent or less) and the Bypass Tunnel Alternative showing a less than 1 percent increase.

Traffic on arterials parallel to SR 99 (except Alaskan Way, which is considered separately below) is expected to decrease by 4 to 5 percent under the Rebuild and Aerial Alternatives. Under the Tunnel and Bypass Tunnel Alternatives, even greater reductions in traffic at the downtown screenline are forecasted (9 and 13 percent respectively). A likely contributing factor to this reduction is that traffic does not have to travel north or south on downtown arterials to access the SR 99 ramps in the downtown area; instead, traffic can use one of several east–west streets to reach Alaskan Way, from which access to SR 99 is provided. Under the Surface Alternative, a 16 percent increase in arterial traffic is forecasted on downtown arterials, as drivers avoid using the congested SR 99 corridor on the waterfront.

Traffic distribution on Alaskan Way surface street varies quite a bit depending on the alternative, since some alternatives rely directly on Alaskan Way to carry corridor ramp or mainline traffic. Under the Rebuild and Aerial Alternatives, Alaskan Way will continue to carry approximately 10,000 vehicles per day. Under the Tunnel Alternative, traffic on Alaskan Way will double, to approximately 21,000 vehicles per day, as this street will be used by traffic traveling between downtown and the south SR 99 corridor. Under the Bypass Tunnel Alternative, Alaskan Way will see a substantial increase in traffic, as trips destined for Belltown, Interbay, and Ballard traffic will also use the corridor along the waterfront. Traffic on Alaskan Way is forecasted to increase to 48,000 daily vehicles at the downtown screenline under the Bypass Tunnel Alternative. The Surface Alternative will rely on Alaskan Way to accommodate mainline movements for SR 99. The forecasted daily volume on SR 99 under the Surface Alternative is 74,000 vehicles. This volume represents nearly a sevenfold increase over the 2030 Existing Facility scenario volumes for Alaskan Way surface street, though it also is substantially less than the mainline SR 99 volumes under the 2030 Existing Facility (126,000 vehicles).

The SR 99 corridor volumes will vary in accordance with the increases forecasted for Alaskan Way for the Rebuild, Aerial, Tunnel, and Bypass Tunnel Alternatives. Mainline volumes under the Rebuild and Aerial Alternatives will be higher at the screenline location, since traffic destined for the Seneca Street off-ramp will still be on the mainline at that point. Under the Tunnel Alternative, SR 99 volumes will be lower since traffic to and from downtown will have already left the corridor (and will be reflected in the Alaskan Way volumes). The same is true for the Bypass Tunnel, except that the reduction in SR 99 traffic (and corresponding increase in Alaskan Way traffic) will be even greater, since trips destined for downtown, Belltown, and other points northwest will have already left the corridor at that point. The total traffic carried on Alaskan Way and SR 99 combined will be similar under these four alternatives, ranging from 138,000 vehicles for the Bypass Tunnel, 139,000 vehicles for the Aerial Alternative, 142,000 vehicles for the Tunnel Alternative, and 143,000 vehicles for the Rebuild Alternative (compared to 137,000 under the 2030 Existing Facility scenario). As identified previously, the Surface Alternative will accommodate substantially lower volumes on the combined SR 99/Alaskan Way corridor at the downtown screenline (74,000 vehicles).

South Screenline

The south screenline runs east–west just north of Spokane Street, crossing E. Marginal Way, SR 99, the arterials between SR 99 and I-5, and I-5. This screenline captures traffic distribution changes resulting from the alternatives as traffic enters or exits the study area to the south.

Total daily traffic volumes entering and exiting in the south end of the study area will be essentially unchanged from the 2030 Existing Facility scenario for the Rebuild, Aerial, Tunnel, and Bypass Tunnel Alternatives. Under the Surface Alternative, daily traffic volumes will decrease by 2 percent across the screenline, again due to the capacity constraints to the north in the central corridor.

Traffic volumes on I-5 are forecasted to increase slightly on I-5 under the Tunnel and Bypass Tunnel Alternatives (less than 1 percent), as well as under the Surface Alternative (2 percent). In all cases, traffic on parallel arterials is forecasted to decrease as the new SR 99 northbound off-ramp and southbound on-ramp proposed at SR 519 will provide new connectivity to and from the south in the stadium area. Trips formerly using E. Marginal Way, First Avenue S., and other north–south arterials to access the stadium area or Pioneer Square could instead use SR 99 under any of the alternatives. With the new ramps, traffic on parallel arterials is forecasted to decrease by 4 to 7 percent depending on the alternative.

Traffic on SR 99 is forecasted to increase by roughly corresponding amounts: 6 percent for Rebuild, Tunnel, and Bypass Tunnel Alternatives and 9 percent for the Aerial Alternative. As shown previously in Exhibits 5-18 and 5-19, this segment of SR 99 has sufficient capacity to accommodate the added traffic under each of these alternatives.

While traffic will shift from the arterials to SR 99 under the Surface Alternative at the south screenline as well, through trips on the corridor will decrease to the point that traffic at the southern segment of SR 99 is forecasted to decrease overall (-5 percent).

5.3.8 Arterial Traffic Operations

MOE H9: Arterial Intersection Performance

Key Findings

- Traffic operations at the intersections of First Avenue and S. Royal Brougham Way and First Avenue and S. Atlantic Street will be similar or somewhat improved under all Build Alternatives when compared with the 2030 Existing Facility, even with additional access provided to SR 99 at S. Atlantic Street.
- The relocation of ferry access to the intersection of Alaskan Way and King Street in the Pioneer Square/stadium area is expected to result in increased levels of congestion at that intersection under the Rebuild, Tunnel, Bypass Tunnel, and Surface Alternatives, but improved conditions on the central waterfront at Alaskan Way and Yesler Way.
- The Surface Alternative will result in a substantial increase in the number of congested intersections in the central sub-area. The Tunnel and Bypass Tunnel Alternatives are anticipated to offer some improvement overall to traffic operations in the downtown area due to the redistribution of traffic accessing SR 99 to several east–west streets, rather than to a single street (Columbia Street).
- Congested conditions are anticipated at Alaskan Way and Marion Street for all alternatives, due to ferry egress traffic. None of the alternatives appears to offer any substantial advantage for traffic exiting Colman Dock, though more congestion is expected elsewhere in the downtown area under the Surface Alternative, which could affect ferry operations.

- The Tunnel and Bypass Tunnel Alternatives relocate access to SR 99 in the Belltown area from Elliott/Western to Alaskan Way, which will result in lower levels of congestion on Elliott and Western Avenues, but higher levels of congestion on Alaskan Way north of Pike Street.
- The number of congested intersections in the South Lake Union area will increase under the Build Alternatives that include conversion of Mercer Street to a two-way street (Aerial, Tunnel, Bypass Tunnel, and Surface Alternatives).

To assess the impacts of each alternative on the broader transportation system, intersection operations at adjacent and nearby intersections are presented. Traffic operations on other study area streets and highways can be affected by either redistribution effects (as described in the previous section) caused by changes to corridor capacity, or by relocation of access points to the SR 99 corridor, which affects how traffic distributes to and from the SR 99 corridor.

Two measures of intersection performance are presented for 2030 PM peak hour conditions. LOS is a standard measure of intersection performance that describes the degree of congestion forecasted. LOS is based on the average vehicle delay forecasted for the intersection analyzed and is measured on a scale from A (best level of service, representing free flow conditions), to F (very congested, break-down conditions). The second measure evaluated is Intersection Capacity Utilization (ICU), which is a measure that is equivalent to volume-to-capacity ratio. Unlike LOS, which is dependent on future signal timing assumptions, ICU is gauged solely on the basic capacity provided by the roadway geometry and the volume of traffic projected. ICU measures the extent to which the basic capacity of an intersection is being utilized, with a measure of 100 percent representing an intersection operating at its theoretical capacity.

The intersection analysis results are presented for four sub-areas:

- South (Stadium Area)
- Central
- North Waterfront
- North (South Lake Union)

The major intersections chosen for analysis were selected based on several factors: proximity to the SR 99 corridor, location near or on SR 99 access routes, forecasted traffic volumes, and existing LOS were all considered when selecting intersections for analysis under 2030 conditions. Intersections directly affected by, or created as a result of, implementation of an alternative were also selected for analysis. Only signalized intersections (existing or proposed) were analyzed.

Intersections that are projected to operate with especially long delays or overcapacity during the PM peak hour are identified as "congested intersections." These congested intersections are those that operate under LOS F conditions (average vehicle delay of greater than 80 seconds) or ICU greater than 100 percent. Congested intersections are further identified as "highly congested" if they exceed 110 seconds of average vehicle delay and have an ICU of greater than 110 percent, or "moderately congested" if they fall below those criteria.

Overall, 15 intersections were identified as congested under the 2030 Existing Facility scenario, up from 10 today. Five of these intersections were identified as highly congested. Under the Rebuild, Tunnel, and Bypass Tunnel Alternatives, similar overall levels of arterial congestion are forecasted. Under each of these alternatives, either 15 or 16 intersections were identified as congested, though fewer highly congested intersections were in each case than under the 2030 Existing Facility scenario. Under the Aerial Alternative, the number of congested intersections is forecasted to increase to 18, though the number of these that are highly congested will decrease compared to the 2030 Existing Facility. Under the Surface Alternative, surface street congestion is forecasted to increase, with 23 intersections identified as congested. Eight of these were identified as highly congested. Results are summarized in Exhibit 5-26.

South Sub-Area

Exhibit 5-27 summarizes congested intersections by alternative for the south sub-area. Under each alternative, the intersections of S. Royal Brougham Way and First Avenue S., and S. Atlantic Street and First Avenue S. are forecasted to operate at congested conditions during the PM peak hour. Still, these intersections improve compared to the 2030 Existing Facility due to the redistribution of traffic in the area that results from relocation of SR 99 access in the stadium area.

Under the Rebuild, Aerial, Tunnel, and Bypass Tunnel Alternatives, the new intersection at the ramps from SR 99 (Alaskan Way collector-distributor) and S. Royal Brougham Way are also forecasted to operate at congested conditions due to heavy use of the northbound on-ramp to SR 99. Under the Surface Alternative, this intersection is not forecasted to operate under congested conditions since the northbound SR 99 on-ramp is not heavily used due to capacity constraints on SR 99 through downtown.

Detailed intersection analysis results for the south sub-area are shown in Exhibits 5-28 through 5-30.

Exhibit 5-26. Congested Intersections by Sub-area

	Street	2002 Existing	2030 Existing Facility	Rebuild	Aerial	Tunnel	Bypass Tunnel	Surface
South	*Moderately Congested*	*0*	*0*	*3*	*3*	*3*	*3*	*2*
	Highly Congested	*0*	*2*	*0*		*0*	*0*	*0*
	Congested Intersections	0	2	3	3	3	3	2
Central	*Moderately Congested*	*7*	*5*	*5*	*5*	*4*	*3*	*7*
	Highly Congested	*0*	*3*	*2*	*2*	*1*	*2*	*7*
	Congested Intersections	7	8	7	7	5	5	14
North Waterfront	*Moderately Congested*	*0*	*0*	*0*	*0*	*1*	*1*	*0*
	Highly Congested	*0*	*0*	*0*	*0*	*0*	*0*	*0*
	Congested Intersections	0	0	0	0	1	1	0
North	*Moderately Congested*	*3*	*5*	*5*	*7*	*7*	*7*	*6*
	Highly Congested	*0*	*0*	*0*	*1*	*0*	*0*	*1*
	Congested Intersections	3	5	5	8	7	7	7
Total	*Moderately Congested*	*10*	*10*	*13*	*15*	*15*	*14*	*15*
	Highly Congested	*0*	*5*	*2*	*3*	*1*	*2*	*8*
	Congested Intersections	10	15	15	18	16	16	23

Exhibit 5-27. Congested Intersections, South

Street	Cross Street	2002 Existing	2030 Existing Facility	Rebuild	Aerial	Tunnel	Bypass Tunnel	Surface
Alaskan Way (CD SB)	S. Royal Brougham Way							
Alaskan Way (CD SB)	S. Atlantic Street							
Alaskan Way (CD NB)	S. Royal Brougham Way			MC	MC	MC	MC	
Alaskan Way (CD NB)	S. Atlantic Street							
First Avenue	S. Royal Brougham Way		HC	MC	MC	MC	MC	MC
First Avenue	S. Atlantic Street		HC	MC	MC	MC	MC	MC
Moderately Congested Intersections		0	0	3	2	3	3	2
Heavily Congested Intersections		0	2	0	0	0	0	0
Total Congested Intersections		0	2	3	2	3	3	2

MC Congested Intersections (LOS F <u>or</u> ICU > 100%)

HC Highly Congested Intersections (Delay > 110 seconds per vehicle <u>and</u> ICU > 110%)

Exhibit 5-28. Signalized Intersection Level of Service (LOS), South

Street	Cross Street	2002 Existing	2030 Existing Facility	Rebuild	Aerial	Tunnel	Bypass Tunnel	Surface
Alaskan Way (CD SB)	S. Royal Brougham Way	C	C	B	B	B	C	A
Alaskan Way (CD SB)	S. Atlantic Street			A	B	A	A	B
Alaskan Way (CD NB)	S. Royal Brougham Way			D	C	C	B	A
Alaskan Way (CD NB)	S. Atlantic Street			B	A	B	B	B
First Avenue	S. Royal Brougham Way	E	F	F	F	F	F	F
First Avenue	S. Atlantic Street	B	F	F	F	E	E	E

Exhibit 5-29. Signalized Intersection Average Vehicle Delay (seconds), South

Street	Cross Street	2002 Existing	2030 Existing Facility	Rebuild	Aerial	Tunnel	Bypass Tunnel	Surface
Alaskan Way (CD SB)	S. Royal Brougham Way	21	23	15	19	11	22	9
Alaskan Way (CD SB)	S. Atlantic Street			5	18	8	8	12
Alaskan Way (CD NB)	S. Royal Brougham Way			54	28	33	18	9
Alaskan Way (CD NB)	S. Atlantic Street			15	3	12	13	13
First Avenue	S. Royal Brougham Way	74	123	84	99	108	97	89
First Avenue	S. Atlantic Street	17	132	84	109	77	80	77

Exhibit 5-30. Signalized Intersection Capacity Utilization (ICU), South

Street	Cross Street	2002 Existing	2030 Existing Facility	Rebuild	Aerial	Tunnel	Bypass Tunnel	Surface
Alaskan Way (CD SB)	S. Royal Brougham Way	55%	67%	72%	79%	79%	79%	47%
Alaskan Way (CD SB)	S. Atlantic Street			85%	69%	72%	72%	79%
Alaskan Way (CD NB)	S. Royal Brougham Way			128%	108%	120%	105%	52%
Alaskan Way (CD NB)	S. Atlantic Street			74%	60%	69%	73%	80%
First Avenue	S. Royal Brougham Way	98%	118%	115%	121%	126%	123%	114%
First Avenue	S. Atlantic Street	77%	144%	117%	121%	113%	114%	115%

2030 Existing Facility

Under 2030 Existing Facility conditions, two signalized intersections in the south sub-area are identified as highly congested. Both S. Royal Brougham Way/First Avenue S. and S. Atlantic Street/First Avenue S. are forecasted to operate at LOS F and highly overcapacity conditions (ICU of 118 percent and 144 percent respectively).

Rebuild Alternative

The two intersections forecasted to operate highly congested in the 2030 Existing Facility—S. Royal Brougham Way/First Avenue S. and S. Atlantic Street/First Avenue S.—are expected to improve to moderately congested conditions under the Rebuild Alternative. This improvement can be attributed to redistribution of trips to S. Atlantic Street and S. Royal Brougham Way to access SR 99, as well as to signal timing and intersection improvements to accommodate these trips.

The new intersection of the northbound collector-distributor of SR 99 (Alaskan Way CD) and S. Royal Brougham Way is forecasted to operate at highly overcapacity conditions, despite operating at LOS D. This high ICU designation is due primarily to the high number of vehicles turning right to access northbound SR 99. While this intersection is likely to experience some level of congestion, the LOS results indicate that the ICU measure may be overestimating the severity in this case.

Aerial Alternative

The intersections of S. Royal Brougham Way/First Avenue S. and S. Atlantic Street/First Avenue S. are expected to improve to moderately congested conditions under the Aerial Alternative for reasons similar to those described for the Rebuild Alternative. Also as with the Rebuild Alternative, the northbound Alaskan Way CD is forecasted to operate under congested conditions.

Tunnel Alternative

As with the other Build Alternatives, the intersections of S. Royal Brougham Way/First Avenue S. and S. Atlantic Street/First Avenue S. are expected to improve to moderately congested conditions under the Tunnel Alternative, while the northbound Alaskan Way CD is forecasted to operate under congested conditions.

Bypass Tunnel Alternative

As with the other Build Alternatives, the intersections of S. Royal Brougham Way/First Avenue S. and S. Atlantic Street/First Avenue S. are expected to improve to moderately congested conditions under the Bypass Tunnel

Alternative, while the northbound Alaskan Way CD is forecasted to operate under congested conditions.

Surface Alternative

As with the other Build Alternatives, the intersections of S. Royal Brougham Way/First Avenue S. and S. Atlantic Street/First Avenue S. are expected to improve to moderately congested conditions under the Bypass Tunnel Alternative. The northbound S. Royal Brougham Way/northbound Alaskan Way CD road is not forecasted to operate under congested operations in the PM peak hour under the Surface Alternative because traffic volumes accessing the northbound SR 99 on-ramp are expected to be small.

Central Sub-Area

Exhibit 5-31 summarizes congested intersections by alternative for the central sub-area, which comprises areas downtown, along the central waterfront, and in Pioneer Square.

Under 2030 Existing Facility conditions, eight intersections are forecasted to operate under congested conditions (three of which will be highly congested). The Rebuild and Aerial Alternatives show some improvement in arterial operations in the central sub-area, with seven intersections forecasted to operate under congested conditions (two highly congested). The Tunnel and Bypass Tunnel Alternatives show a greater degree of improvement to surface street operations in the central sub-area, as five intersections are predicted to operate under congested conditions (with one highly congested under the Tunnel Alternative, and two under the Bypass Tunnel Alternative).

The Surface Alternative is forecasted to increase congestion on surface streets in the central sub-area, as 14 intersections are forecasted to operate under congested conditions (seven under highly congested congestions). Seven of these congested intersections are located on Alaskan Way, which serves as SR 99 under the Surface Alternative.

Detailed intersection analysis results for the central sub-area are shown in Exhibits 5-32 through 5-34.

2030 Existing Facility Scenario

Since traffic in the downtown during the PM peak hour is expected to grow only minimally, intersection signal timings were presumed to utilize the same cycle lengths as under existing conditions. As such, any current inefficiencies resulting from current signal timings are also evident in the 2030 Existing Facility scenario. It should be noted that signal timing assumptions are optimized under the Build Alternatives, since each of the alternatives results in unique redistributions of traffic.

Exhibit 5-31. Congested Intersections, Central

Street	Cross Street	2002 Existing	2030 Existing Facility	Rebuild	Aerial	Tunnel	Bypass Tunnel	Surface
Alaskan Way	Seneca Street							MC
Alaskan Way	Spring Street							MC
Alaskan Way	Madison Street							HC
Alaskan Way	Marion Street	MC	HC	HC	HC	HC	HC	MC
Alaskan Way	Columbia Street							MC
Alaskan Way	Yesler Way	MC	MC		MC			MC
Alaskan Way	S. Main Street							
Alaskan Way	S. Jackson Street							
Alaskan Way	S. King Street						MC	HC
Western Avenue	Wall Street		MC					
Western Avenue	Battery Street							
Western Avenue	Seneca Street							
Western Avenue	Spring Street							
Western Avenue	Madison Street							
Western Avenue	Marion Street							
First Avenue	Seneca Street							
First Avenue	Spring Street							MC
First Avenue	Madison Street	MC				MC		
First Avenue	Marion Street		MC	MC	MC			HC
First Avenue	Columbia Street	MC	HC	HC	HC			HC
First Avenue	S. Main Street							
First Avenue	S. Jackson Street			MC				
Second Avenue	Spring Street	MC	MC	MC	MC	MC	MC	HC
Second Avenue	Madison Street	MC	HC	MC	MC	MC	HC	HC
Second Avenue	Marion Street	MC	MC	MC	MC	MC	MC	HC
Second Avenue	Columbia Street							MC
Moderately Congested Intersections		7	5	5	5	4	3	7
Heavily Congested Intersections		0	3	2	2	1	2	7
Total Congested Intersections		7	8	7	7	5	5	14

MC Congested Intersections (LOS F or ICU > 100%)
HC Highly Congested Intersections (Delay > 110 seconds per vehicle and ICU > 110%)

Exhibit 5-32. Signalized Intersection Level of Service (LOS), Central

Street	Cross Street	2002 Existing	2030 Existing Facility	Rebuild	Aerial	Tunnel	Bypass Tunnel	Surface
Alaskan Way	Seneca Street					B	A	E
Alaskan Way	Spring Street						A	B
Alaskan Way	Madison Street	D	C	C	B	D	E	F
Alaskan Way	Marion Street	D	F	F	F	F	F	F
Alaskan Way	Columbia Street	D	B	A	A	D	C	F
Alaskan Way	Yesler Way	F	F	A	F	D	B	F
Alaskan Way	S. Main Street	B	C	B	B	B	A	A
Alaskan Way	S. Jackson Street	A	A	A	A	A	A	C
Alaskan Way	S. King Street			E		E	F	F
Western Avenue	Wall Street	C	E	D	D	A	A	B
Western Avenue	Battery Street	B	B	B	A	A	A	A
Western Avenue	Seneca Street							B
Western Avenue	Spring Street	B	A	A	A	B	A	D
Western Avenue	Madison Street	B	B	B	A	B	B	A
Western Avenue	Marion Street	B	B	A	B	B	B	B
First Avenue	Seneca Street	B	C	C	C	B	C	C
First Avenue	Spring Street	D	D	D	C	D	E	F
First Avenue	Madison Street	F	D	E	D	F	E	E
First Avenue	Marion Street	C	E	D	D	D	E	F
First Avenue	Columbia Street	F	F	F	F	C	E	F
First Avenue	S. Main Street	C	B	C	C	C	D	B
First Avenue	S. Jackson Street	C	E	E	E	D	E	E
Second Avenue	Spring Street	F	F	F	F	F	F	F
Second Avenue	Madison Street	F	F	F	F	F	F	F
Second Avenue	Marion Street	F	F	F	F	F	F	F
Second Avenue	Columbia Street	D	E	E	E	B	C	F

Exhibit 5-33. Signalized Intersection Average Vehicle Delay (seconds), Central

Street	Cross Street	2002 Existing	2030 Existing Facility	Rebuild	Aerial	Tunnel	Bypass Tunnel	Surface
Alaskan Way	Seneca Street					10	7	68
Alaskan Way	Spring Street						8	13
Alaskan Way	Madison Street	52	31	33	19	50	72	116
Alaskan Way	Marion Street	43	171	141	138	155	148	85
Alaskan Way	Columbia Street	47	18	9	8	47	24	96
Alaskan Way	Yesler Way	80	124	10	113	54	14	99
Alaskan Way	S. Main Street	11	21	14	15	17	10	7
Alaskan Way	S. Jackson Street	2	2	2	9	9	2	24
Alaskan Way	S. King Street			57		61	87	158
Western Avenue	Wall Street	31	71	41	44	9	9	16
Western Avenue	Battery Street	12	11	10	0	0	0	0
Western Avenue	Seneca Street							11
Western Avenue	Spring Street	11	9	9	8	11	10	38
Western Avenue	Madison Street	12	13	12	10	19	12	8
Western Avenue	Marion Street	14	14	9	13	11	18	11
First Avenue	Seneca Street	19	23	24	22	12	32	35
First Avenue	Spring Street	37	49	38	34	41	57	85
First Avenue	Madison Street	82	53	57	36	88	72	63
First Avenue	Marion Street	21	60	45	44	52	62	128
First Avenue	Columbia Street	89	151	154	145	29	60	222
First Avenue	S. Main Street	21	20	34	33	32	41	13
First Avenue	S. Jackson Street	26	70	73	62	43	64	66
Second Avenue	Spring Street	192	185	166	166	114	176	225
Second Avenue	Madison Street	141	225	125	121	126	147	171
Second Avenue	Marion Street	145	117	129	132	133	159	156
Second Avenue	Columbia Street	44	66	64	61	17	22	185

Exhibit 5-34. Signalized Intersection Capacity Utilization (ICU), Central

Street	Cross Street	2002 Existing	2030 Existing Facility	Rebuild	Aerial	Tunnel	Bypass Tunnel	Surface
Alaskan Way	Seneca Street					56%	74%	105%
Alaskan Way	Spring Street						94%	109%
Alaskan Way	Madison Street	81%	91%	91%	84%	84%	98%	111%
Alaskan Way	Marion Street	125%	156%	149%	148%	132%	127%	102%
Alaskan Way	Columbia Street	65%	68%	63%	63%	88%	82%	104%
Alaskan Way	Yesler Way	104%	109%	43%	106%	95%	90%	98%
Alaskan Way	S. Main Street	66%	68%	67%	67%	79%	87%	85%
Alaskan Way	S. Jackson Street	71%	75%	72%	75%	84%	71%	99%
Alaskan Way	S. King Street			84%		93%	101%	121%
Western Avenue	Wall Street	92%	103%	96%	97%	59%	59%	80%
Western Avenue	Battery Street	62%	70%	70%	54%	36%	27%	41%
Western Avenue	Seneca Street							57%
Western Avenue	Spring Street	71%	71%	71%	71%	61%	65%	60%
Western Avenue	Madison Street	55%	58%	64%	61%	62%	55%	55%
Western Avenue	Marion Street	59%	55%	55%	55%	59%	56%	57%
First Avenue	Seneca Street	77%	85%	84%	82%	60%	61%	68%
First Avenue	Spring Street	85%	92%	90%	87%	90%	97%	116%
First Avenue	Madison Street	67%	72%	73%	69%	78%	79%	82%
First Avenue	Marion Street	85%	111%	105%	105%	81%	89%	130%
First Avenue	Columbia Street	119%	131%	133%	129%	90%	95%	192%
First Avenue	S. Main Street	57%	72%	80%	80%	77%	82%	68%
First Avenue	S. Jackson Street	75%	97%	104%	99%	90%	96%	82%
Second Avenue	Spring Street	92%	101%	101%	101%	102%	101%	115%
Second Avenue	Madison Street	100%	144%	109%	109%	109%	113%	128%
Second Avenue	Marion Street	88%	98%	98%	100%	102%	105%	115%
Second Avenue	Columbia Street	84%	92%	92%	92%	77%	83%	107%

Under 2030 Existing Facility conditions, eight signalized intersections in the downtown area are identified as congested, five of which are highly congested. Three of the four intersections studied on Second Avenue are expected to be congested under 2030 conditions, due primarily to the heavy volumes of commute traffic leaving the downtown area. One of these (at Madison Street) is expected to operate under highly congested conditions. On First Avenue, the intersection with Columbia Street is expected to operate under heavily congested conditions. This intersection serves as the access point to southbound SR 99 from downtown, and therefore congregates traffic accessing SR 99. The intersection of First Avenue and Marion Street is forecasted to operate under congested conditions, due to the interaction between ferry traffic leaving Colman Dock via Marion Street with heavy commute traffic on First Avenue.

The other heavily congested intersections in the downtown are located on Alaskan Way at Yesler Way and Marion Street, both of which provide access and egress from the Colman Dock Ferry Terminal. All access to Colman Dock is provided at Yesler Way via a northbound left turn, while traffic exiting the dock uses either Yesler Way (southbound left turn only) or Marion Street.

The intersection of Western Avenue and Wall Street is identified as congested, due to heavy volumes from the northbound Western Avenue off-ramp combining with local traffic from downtown as well as exiting traffic from the southbound Battery Street off-ramp.

Rebuild Alternative

Traffic operations on central sub-area intersections under the Rebuild Alternative generally mirror those under the 2030 Existing Facility scenario with two notable exceptions. The first is that, as with all of the Build Alternatives, traffic signal timings were adjusted to provide the best operations possible given the projected traffic volumes (cycle lengths in particular were adjusted on an areawide basis), and as such, the amount of delay expected on Second Avenue decreased relative to the 2030 Existing Facility scenario. Still, congested conditions are expected at all intersections on Second Avenue. The second difference is that under the Rebuild Alternative, ferry traffic access to Colman Dock will be provided remotely via a parallel frontage road with access at King Street and Alaskan Way (see Pioneer Square/Stadium Area discussion). Removing ferry access traffic from the central waterfront is expected to substantially improve local traffic operations on Alaskan Way at Yesler Way. Correspondingly, the intersection of King Street and Alaskan Way suffers degraded operations compared to the 2030 Existing Facility, but not to the point of being identified as congested. Note that traffic conditions associated with Colman Dock traffic vary based on demand levels and distribution of traffic existing the dock, and conditions presented here are considered peak (or worst case). For more detail, see Section 5.6.

Aerial Alternative

Traffic operations under the Aerial Alternative in the central sub-area are expected to closely mirror those of the 2030 Existing Facility scenario, with some modest improvement in delay (particularly on Second Avenue) due to improved traffic signal optimization. Like the 2030 Existing Facility scenario, the Aerial Alternative will provide access to Colman Dock at Yesler Way, and as such, is forecasted to operate overcapacity and under heavily congested conditions at that location. Note that traffic conditions associated with Colman Dock traffic vary based on demand levels and distribution of traffic existing the dock, and conditions presented here are considered peak (or worst case). For more detail, see Section 5.6.

Tunnel Alternative

The Tunnel Alternative is forecasted to result in the fewest congested intersections in the central sub-area of the alternatives studied. This is primarily due to the redistribution of traffic expected as a result of the access provided to SR 99. Under the Tunnel Alternative, north–south arterial movements on First Avenue and Second Avenue will decrease, Alaskan Way will be improved to accommodate increased traffic, and traffic destined for southbound SR 99 will not be concentrated to a single ramp location. As a result, fewer congested or overcapacity intersections are forecasted in the downtown area.

Intersections on expanded Alaskan Way will operate at LOS D, with the exception of the intersection at Marion Street, which, as with the other Build Alternatives, will operate at an overall LOS F due to exiting ferry traffic. Intersection capacity utilization confirms this result, though it shows a slightly lower ICU than for the 2030 Existing Facility, Rebuild, or Aerial Alternatives, which suggests that the Tunnel Alternative provides capacity sufficient to accommodate exiting ferry traffic as well as or better than the existing configuration. Note that traffic conditions associated with Colman Dock traffic vary based on demand levels and distribution of traffic existing the dock, and conditions presented here are considered peak (or worst case). For more detail, see Section 5.6.

Bypass Tunnel Alternative

The Bypass Tunnel Alternative will result in similar traffic operations in the central sub-area as found for the Tunnel Alternative. Five intersections were identified as congested, with two of those being highly congested. Note that under the Bypass Tunnel Alternative, the intersection of Alaskan Way at King Street is identified as moderately congested, due to high volumes on Alaskan Way and the introduction of ferry access at King Street. Note that traffic conditions associated with Colman Dock traffic vary based on demand levels and distribution of traffic existing the dock, and conditions presented here are considered peak (or worst case). For more detail, see Section 5.6.

Surface Alternative

Given the capacity constraints on the SR 99 corridor, increased dependence on downtown arterials is forecasted under the Surface Alternative. As a result of higher traffic volumes on these streets, the number of intersections in the central sub-area that will operate at congested conditions or overcapacity is forecasted to increase. In particular, increased congestion is forecasted downtown on Second Avenue, First Avenue, and Alaskan Way (which serves as the SR 99 corridor under the Surface Alternative). The number of congested intersections (14) and the degree of congestion (seven highly congested) will both increase under the Surface Alternative relative to the other Build Alternatives and the 2030 Existing Facility Scenario.

The intersection of S. King Street and Alaskan Way, which is the first signalized intersection on the SR 99 mainline entering the downtown area in the south, is expected to operate under highly congested conditions. While access to the remote holding site for ferry traffic will be provided at this location, the primary case of the increased congestion is the high volumes forecasted for the corridor, which also serves as the SR 99 mainline through downtown Seattle. Because of the congestion anticipated on Alaskan Way under this alternative, additional access to the ferry holding site was presumed from S. Atlantic Street and S. Royal Brougham Way through the Terminal 46 property under the Surface Alternative. Note that traffic conditions associated with Colman Dock traffic vary based on demand levels and distribution of traffic existing the dock, and conditions presented here are considered peak (or worst case). For more detail, see Section 5.6.

It should be noted that in the Surface Alternative, First Avenue is assumed to consist of two travel lanes in each direction through the Pioneer Square/ stadium area. With a four-lane configuration, First Avenue would operate at similar congestion levels as today, though higher traffic volumes are forecasted. If instead the two-lane configuration through Pioneer Square were maintained, traffic operations on First Avenue would degrade substantially, and other parallel facilities (SR 99, Fourth Avenue, and I-5) could experience some additional increase in traffic.

North Waterfront Sub-Area

Exhibit 5-35 summarizes congested intersections by alternative for the north waterfront sub-area. For this small sub-area, intersections in the vicinity of Alaskan Way and Broad Street were analyzed. Other nearby intersections are analyzed under the north and central sub-areas.

The 2030 Existing Facility and the Build Alternatives presumed the separate development of a planned new undercrossing of the BNSF mainline linking

Alaskan Way (near Broad Street) to Elliott Avenue (north of Broad Street). Under the Tunnel and Bypass Tunnel Alternatives, the new route created by this connection will experience increased usage since no direct connections to the Elliott Avenue/Western Avenue couplet are proposed, and traffic will instead access Alaskan Way. As a result, the new intersection of the undercrossing (Alaskan Way extension) at Elliott Avenue will operate under congested conditions for these two alternatives. Note that either alternative could be constructed instead with connections to Elliott Avenue/Western Avenue as a design option, and would operate similar to the Rebuild and Aerial Alternatives in that case.

Detailed intersection analysis results for the north waterfront sub-area are shown in Exhibits 5-36 through 5-38.

Exhibit 5-35. Congested Intersections, North Waterfront

Street	Cross Street	2002 Existing	2030 Existing Facility	Rebuild	Aerial	Tunnel	Bypass Tunnel	Surface
Alaskan Way	Broad Street							
Elliott Avenue	Alaskan Way Extension					MC	MC	
Elliott Avenue	Broad Street							
	Moderately Congested Intersections	0	0	0	0	1	1	0
	Heavily Congested Intersections	0	0	0	0	0	0	0
	Total Congested Intersections	0	0	0	0	1	1	0

MC Congested Intersections (LOS F <u>or</u> ICU > 100%)
HC Highly Congested Intersections (Delay > 110 seconds per vehicle <u>and</u> ICU > 110%)

Exhibit 5-36. Signalized Intersection Level of Service (LOS), North Waterfront

Street	Cross Street	2002 Existing	2030 Existing Facility	Rebuild	Aerial	Tunnel	Bypass Tunnel	Surface
Alaskan Way	Broad Street		A	A	B	D	B	A
Elliott Avenue	Alaskan Way Ext		A	A	B	F	D	B
Elliott Avenue	Broad Street	C	C	C	D	B	B	C

Exhibit 5-37. Signalized Intersection Average Vehicle Delay (seconds), North Waterfront

Street	Cross Street	2002 Existing	2030 Existing Facility	Rebuild	Aerial	Tunnel	Bypass Tunnel	Surface
Alaskan Way	Broad Street		6	9	12	49	19	9
Elliott Avenue	Alaskan Way Ext		8	9	14	107	40	13
Elliott Avenue	Broad Street	28	32	25	38	20	12	25

Exhibit 5-38. Signalized Intersection Capacity Utilization (ICU), North Waterfront

Street	Cross Street	2002 Existing	2030 Existing Facility	Rebuild	Aerial	Tunnel	Bypass Tunnel	Surface
Alaskan Way	Broad Street		41%	53%	49%	93%	82%	72%
Elliott Avenue	Alaskan Way Ext		72%	63%	76%	128%	108%	80%
Elliott Avenue	Broad Street	68%	76%	75%	76%	68%	66%	67%

2030 Existing Facility

None of the intersections studied were identified as congested during the PM peak hour under the 2030 Existing Facility scenario. Note that railroad operations on the BNSF mainline east of Alaskan Way regularly disrupt traffic flow throughout the day, which can lead to congested conditions beyond those reported by the analysis conducted.

Rebuild Alternative

None of the intersections studied were identified as congested during the PM peak hour under the Rebuild Alternative. Note that railroad operations on the BNSF mainline east of Alaskan Way regularly disrupt traffic flow throughout the day, which can lead to congested conditions beyond those reported by the analysis conducted.

Aerial Alternative

None of the intersections studied were identified as congested during the PM peak hour under the Aerial Alternative. Note that railroad operations on the BNSF mainline east of Alaskan Way regularly disrupt traffic flow throughout the day, which can lead to congested conditions beyond those reported by the analysis conducted.

Tunnel Alternative

The primary difference between the Tunnel Alternative and the 2030 Existing Facility scenario is that access to and from SR 99 in this area will be relocated from Elliott and Western Avenues to Alaskan Way. This will shift traffic volumes from Elliott and Western Avenues to Alaskan Way, where the additional volume is forecasted to create congested conditions at the intersection of the Alaskan Way extension (the proposed new undercrossing of the BNSF mainline) and Elliott Avenue. Increased turning movements across the BNSF mainline south of Broad Street could further affect traffic operations in this area.

Design Option

The Tunnel Alternative could instead be constructed with ramps to the Elliott/Western couplet, rather than to Alaskan Way, which would result in traffic conditions similar to under the Rebuild or Aerial Alternatives for intersections in the north waterfront sub-area.

Bypass Tunnel Alternative

The Bypass Tunnel Alternative will operate similarly to the Tunnel Alternative in the north waterfront sub-area, but with less congestion on Alaskan Way. Because the nearest connection to SR 99 is provided at King Street, traffic volumes bound for the Interbay, Magnolia, or Ballard areas via routes through the north waterfront are expected to decrease. Even so, the intersection of the Alaskan Way extension (the proposed new undercrossing of the BNSF mainline) and Elliott Avenue is forecasted to operate under congested conditions. Increased turning movements across the BNSF mainline south of Broad Street could further affect traffic operations in this area.

Design Option

A new arterial connection between Alaskan Way and the Elliott Avenue/Western Avenue couplet could be constructed as a design option. This connection would distribute traffic between Alaskan Way, Elliott Avenue, and Western Avenue and would improve traffic operations at the Alaskan Way extension/Elliott Avenue intersection.

Surface Alternative

The Surface Alternative will provide access to SR 99 at both Elliott/Western Avenues and along Alaskan Way, distributing traffic among these streets. Additionally, overall volumes under the Surface Alternative are expected to be reduced in the Belltown area when compared to the 2030 Existing Facility due to congestion on the SR 99 corridor through downtown, which will limit the number of through trips traveling through these corridors. For these reasons, none of the intersections studied in the north waterfront area were identified as congested during the PM peak hour under the Surface Alternative. Note that railroad operations on the BNSF mainline east of Alaskan Way regularly disrupt traffic flow throughout the day, which can lead to congested conditions beyond those reported by the analysis conducted.

North Sub- Area

Exhibit 5-39 summarizes congested intersections by alternative for the north sub-area, which comprises areas south and west of Lake Union and near the Seattle Center.

Exhibit 5-39. Congested Intersections, North

Street	Cross Street	2002 Existing	2030 Existing Facility	Rebuild	Aerial	Tunnel	Bypass Tunnel	Surface
Elliott Avenue	Denny (Western)	MC	MC	MC	MC	MC		
Broad Street	Denny Way							
First Avenue	Denny Way		MC	MC	MC		MC	MC
Second Avenue	Denny Way	MC	MC	MC	MC	MC	MC	MC
Second Avenue	Battery Street							
Fifth Avenue	Roy Street							
Fifth Avenue	Mercer Street				MC	MC	MC	MC
Fifth Avenue	Thomas Street							
Fifth Avenue	Broad Street							
Fifth Avenue	Denny Way							
Dexter Avenue	Roy Street				HC	MC	MC	HC
Dexter Avenue	Mercer Street				MC	MC	MC	MC
Dexter Avenue	Harrison Street							
Dexter Avenue	Thomas Street							
Dexter Avenue	Denny Way	MC	MC	MC	MC	MC	MC	MC
Aurora NB	Denny Way		MC	MC	MC	MC	MC	MC
Aurora SB	Denny Way							
Moderately Congested Intersections		3	5	5	7	7	7	6
Heavily Congested Intersections		0	0	0	1	0	0	1
Total Congested Intersections		0	5	5	8	7	7	7

C Congested Intersections (LOS F <u>or</u> ICU > 100%)
HC Highly Congested Intersections (Delay > 110 seconds per vehicle <u>and</u> ICU > 110%)

Under 2030 Existing Facility conditions, five intersections are forecasted to operate under congested conditions. All five congested intersections are located on Denny Way and were identified as moderately congested. The Rebuild Alternative will not involve any changes to SR 99 or related streets, and the same intersections are forecasted to be moderately congested under this alternative. Note that removal of the Battery Street ramps will increase traffic through the Denny ramps and at the Denny Way/Dexter Avenue intersection, but operations are not expected to degrade beyond the current moderately congested designation.

Under the other Build Alternatives, Mercer Street will be converted to a two-way roadway under SR 99, replacing the current Mercer Street/Broad Street couplet and returning to a more traditional street grid. Additionally, a new overpass will be constructed over SR 99 at Thomas Street, further connecting areas on either side of SR 99.

The number of congested intersections in the north sub-area is forecasted to increase to seven under the Tunnel, Bypass Tunnel, and Surface Alternatives and eight under the Aerial Alternative during the PM peak hour. The increased congestion is partially due to the transitions between one-way couplets on Mercer Street and Roy Street to the two-way Mercer Street segment at Fifth Avenue and at Dexter Avenue. Note that operational impacts at the Dexter Avenue intersections with Mercer Street and Roy Street could be modified by improvements to Mercer Street and/or Valley Street, as is currently being studied separately by the City of Seattle. These improvements are not necessary for implementation of the street grid improvements proposed under the Aerial, Tunnel, Bypass Tunnel, and Surface Alternatives, but they could potentially improve the intersection performance compared to that reported in this study.

Detailed intersection analysis results for the north sub-area are shown in Exhibits 5-40 through 5-42.

2030 Existing Facility

Under the 2030 Existing Facility conditions, five intersections on Denny Way are forecasted to operate at moderately congested conditions. These intersections are located at First Avenue and Second Avenue near Seattle Center; the intersection of Elliott Avenue and Western Avenue (which Denny Way becomes west of Western Avenue), and near SR 99 at the northbound on-ramp to SR 99 and at the Denny Way/Dexter Avenue intersection.

Exhibit 5-40. Signalized Intersection Level of Service (LOS), North

Street	Cross Street	2002 Existing	2030 Existing Facility	Rebuild	Aerial	Tunnel	Bypass Tunnel	Surface
Elliott Avenue	Denny (Western)	F	F	F	F	F	E	E
Broad Street	Denny Way	C	C	C	C	B	C	B
First Avenue	Denny Way	B	D	D	D	C	C	D
Second Avenue	Denny Way	C	F	F	F	F	F	F
Second Avenue	Battery Street	B	A	B	B	B	B	B
Fifth Avenue	Roy Street	B	B	C	E	D	E	C
Fifth Avenue	Mercer Street	C	B	B	E	E	E	E
Fifth Avenue	Thomas Street				B	B	B	C
Fifth Avenue	Broad Street	C	C	C	B	B	B	C
Fifth Avenue	Denny Way	B	B	B	B	B	B	C
Dexter Avenue	Roy Street	A	A	A	F	F	F	F
Dexter Avenue	Mercer Street	D	D	D	E	E	E	C
Dexter Avenue	Harrison Street	A	A	A	B	B	B	B
Dexter Avenue	Thomas Street				A	A	A	B
Dexter Avenue	Denny Way	B	B	C	C	C	D	E
Aurora NB	Denny Way	D	D	F	E	F	E	F
Aurora SB	Denny Way	B	C	D	C	C	D	C

Exhibit 5-41. Signalized Intersection Average Vehicle Delay (seconds), North

Street	Cross Street	2002 Existing	2030 Existing Facility	Rebuild	Aerial	Tunnel	Bypass Tunnel	Surface
Elliott Avenue	Denny (Western)	100	91	101	84	90	68	60
Broad Street	Denny Way	26	26	28	22	18	27	20
First Avenue	Denny Way	17	51	51	51	25	35	44
Second Avenue	Denny Way	34	108	100	93	92	99	107
Second Avenue	Battery Street	15	8	17	12	14	20	13
Fifth Avenue	Roy Street	15	19	25	56	40	63	26
Fifth Avenue	Mercer Street	30	16	17	57	62	65	77
Fifth Avenue	Thomas Street				14	14	16	20
Fifth Avenue	Broad Street	32	25	26	17	18	20	28
Fifth Avenue	Denny Way	14	19	17	17	15	12	21
Dexter Avenue	Roy Street	7	6	6	122	112	102	136
Dexter Avenue	Mercer Street	50	50	51	61	66	78	29
Dexter Avenue	Harrison Street	7	7	7	16	12	15	14
Dexter Avenue	Thomas Street				10	9	10	16
Dexter Avenue	Denny Way	14	20	29	21	35	42	63
Aurora NB	Denny Way	37	44	85	76	84	80	99
Aurora SB	Denny Way	10	25	40	32	35	42	34

Exhibit 5-42. Signalized Intersection Capacity Utilization (ICU), North

Street	Cross Street	2002 Existing	2030 Existing Facility	Rebuild	Aerial	Tunnel	Bypass Tunnel	Surface
Elliott Avenue	Denny (Western)	105%	105%	111%	106%	108%	100%	100%
Broad Street	Denny Way	77%	91%	91%	85%	85%	92%	85%
First Avenue	Denny Way	95%	112%	112%	111%	98%	109%	111%
Second Avenue	Denny Way	111%	134%	134%	131%	129%	132%	134%
Second Avenue	Battery Street	44%	50%	52%	54%	56%	60%	59%
Fifth Avenue	Roy Street	61%	71%	75%	95%	89%	99%	79%
Fifth Avenue	Mercer Street	60%	73%	74%	111%	114%	118%	115%
Fifth Avenue	Thomas Street				55%	55%	55%	64%
Fifth Avenue	Broad Street	57%	63%	63%	61%	61%	64%	76%
Fifth Avenue	Denny Way	58%	63%	64%	59%	59%	59%	58%
Dexter Avenue	Roy Street	51%	56%	56%	117%	108%	107%	114%
Dexter Avenue	Mercer Street	82%	95%	96%	115%	118%	124%	105%
Dexter Avenue	Harrison Street	37%	53%	53%	66%	68%	80%	76%
Dexter Avenue	Thomas Street				73%	71%	76%	80%
Dexter Avenue	Denny Way	111%	120%	126%	118%	116%	122%	121%
Aurora NB	Denny Way	96%	106%	119%	117%	118%	118%	118%
Aurora SB	Denny Way	54%	60%	63%	65%	66%	69%	55%

Rebuild Alternative

Traffic operations in the South Lake Union area under the Rebuild Alternative are expected to be similar to those under the 2030 Existing Facility scenario. While additional traffic is expected at the Denny ramps and through the Dexter Avenue/Denny Way intersection, this traffic is not expected to degrade performance to theses intersections substantially enough to change their designation as moderately congested intersections.

Aerial Alternative

In the Aerial Alternative, Mercer Street will be converted to two-way operations between Fifth Avenue and Dexter Avenue, and Broad Street will be abandoned between Dexter Avenue and Harrison Street. Three intersections where the two-way section of Mercer Street will transition back to the current couplet configuration are expected to operate under congested conditions: Mercer

Street/Dexter Avenue and Mercer Street/Fifth Avenue at congested conditions, and Roy Street/Dexter Avenue at highly congested conditions. Note that operational impacts at these intersections could be modified by improvements to Mercer Street and/or Valley Street, as is currently being studied separately by the City of Seattle. These improvements are not necessary for implementation of the street grid improvements proposed under the Aerial, Tunnel, Bypass Tunnel, and Surface Alternatives, but they could potentially improve the intersection performance compared to that reported in this study.

Overall, intersections on Denny Way in the Aerial Alternative are expected to perform similarly to the 2030 Existing Facility scenario.

Tunnel Alternative

Intersection analysis for the Tunnel Alternative shows essentially the same operational issues as found for the Aerial Alternative, except that the intersection of Roy Street at Dexter Avenue is forecasted to operate at moderately congested (rather than highly congested) conditions under the Tunnel Alternative. Additionally, the intersection of First Avenue and Denny Way is forecasted to improve slightly under the Tunnel Alternative and is not identified as congested.

Bypass Tunnel Alternative

Similar results were found for the Bypass Tunnel Alternative as for the Tunnel Alternative. One difference is that the intersection of First Avenue and Denny Way is expected to operate at congested conditions, but the intersection of Elliott Avenue and Western Avenue further west is not, since lower traffic volumes are expected on the Elliott Avenue/Western Avenue couplet under the Bypass Tunnel Alternative.

Surface Alternative

The Surface Alternative shows very similar results to the Bypass Tunnel Alternative in the north sub-area, but with the intersection of Roy Street/Dexter Way operating at highly congested conditions (rather than moderately congested as under the Bypass Tunnel Alternative).

Impacts to Specific Sensitive Areas

Waterfront Fire Station

The waterfront fire station on Alaskan Way near Colman dock is an important emergency services facility. Traffic operations on Alaskan Way, as well as those on connecting east–west arterials, could affect response time and egress from the waterfront fire station. The Rebuild and Aerial Alternatives will not degrade traffic conditions along the waterfront and are not expected to affect fire station operations compared to the 2030 Existing Facility scenario.

The Tunnel Alternative will increase vehicle activity on Alaskan Way, but improvements to the roadway facility are forecasted to maintain LOS levels at D or better along the waterfront (except for at Marion Street, which will be congested under any alternative). Some improvement in operations on other streets downtown is expected also. In general, the Tunnel Alternative is not expected to affect fire station operations substantially.

The Bypass Tunnel Alternative will introduce substantially higher traffic volumes to the waterfront, as described in Section 5.3.7, Distribution of Traffic. Improvements to Alaskan Way will maintain LOS D or better except at Marion Street (LOS F) and Madison Street (LOS E). Some increase in congestion will be experienced elsewhere in downtown Seattle. Overall, traffic impact to fire station operations is expected to be minimal.

The Surface Alternative will degrade operations along Alaskan Way. LOS F and very congested conditions are expected along Alaskan Way. Other downtown intersections will also experience increased congestion under the Surface Alternative. Fire station operations will be adversely affected by traffic congestion under the Surface Alternative, particularly during peak hours. However, high traffic volumes on Alaskan Way could be expected throughout the day.

Pioneer Square

Potential traffic impacts to Pioneer Square are expected to be minimal under the Build Alternatives, except for the Surface Alternative. Under the other four Build Alternatives, some modest variation in traffic on First Avenue through Pioneer Square is expected, but only minimal variations in congestion between alternatives are forecasted.

Four lanes, rather than two, are necessary to accommodate the increased traffic forecasted through Pioneer Square under the Surface Alternative. With four lanes, traffic congestion and LOS are expected to be acceptable.

Pike Place Market

Changes to the traffic pattern in the immediate vicinity of Pike Place Market are not expected. However, the Surface Alternative, and to a lesser extent the Bypass Tunnel Alternative, is forecasted to increase traffic and congestion on First Avenue. Traffic on Western Avenue is not forecasted to change drastically across alternatives either, even though Western Avenue is used to distribute traffic to the downtown grid several blocks south of the market.

Accessibility to Pike Place Market could be decreased by removal of the southbound off-ramp and northbound on-ramp at Western Avenue (all alternatives).

5.4 Transit

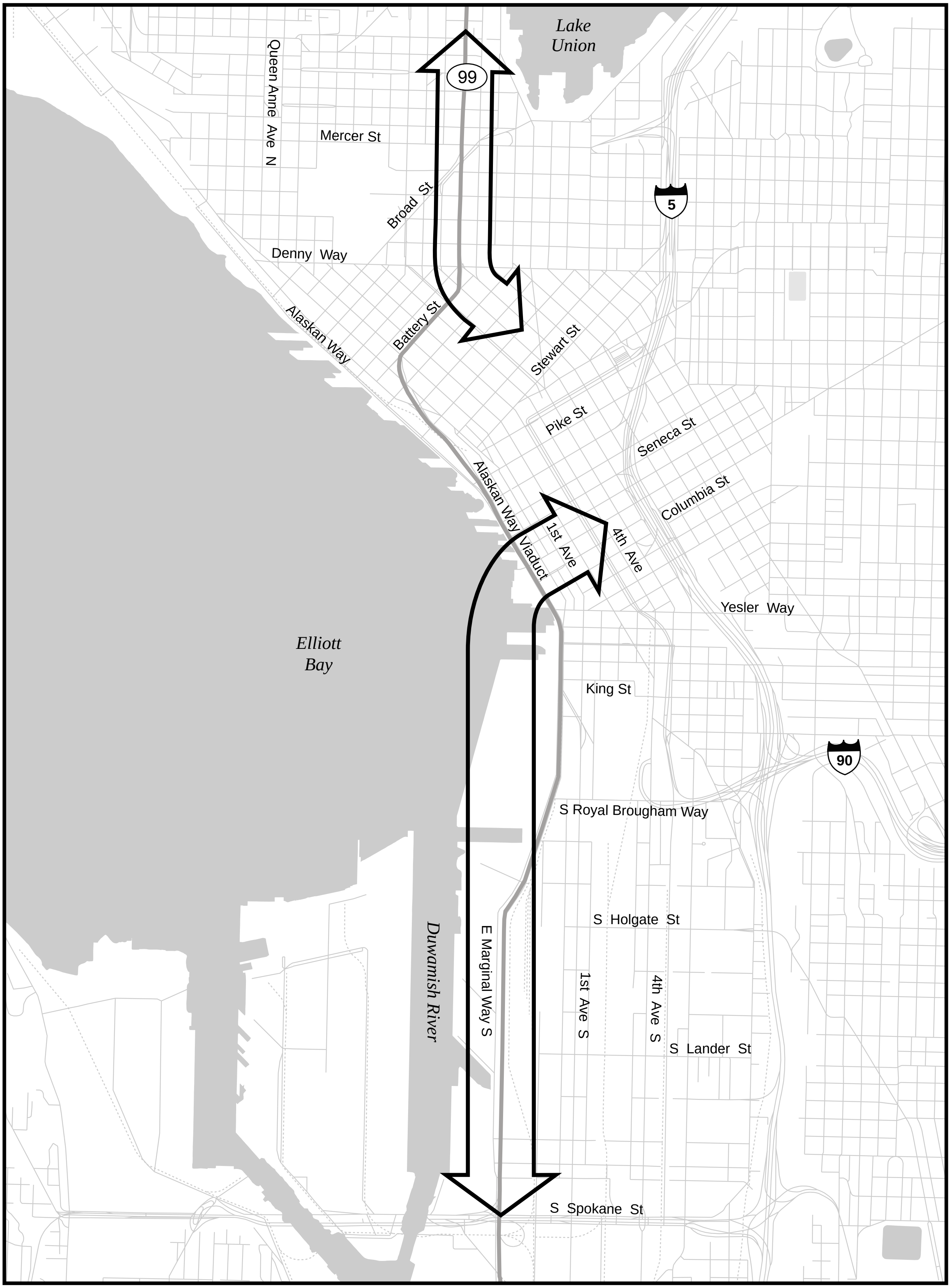
Existing transit services are described in Chapter 4, Affected Environment. Transit services currently utilize the SR 99 corridor to access downtown, but do not travel through downtown on SR 99. Northbound transit routes that serve downtown approach from the south and use the northbound off-ramp at Seneca Street. Southbound trips that originate downtown access southbound SR 99 using the on-ramp at Columbia Street. Transit service from the north of Seattle accesses downtown via the SR 99 off-ramps at Denny Way. Downtown transit service heading north enters SR 99 via the Denny Way on-ramps. No transit services use the Battery Street Tunnel as part of their service routes, and no routes access SR 99 at the Elliott/Western ramps in the north end or at the First Avenue S. ramps in the south end. Local transit services from the south end, primarily King County Metro, and to a lesser extent Sound Transit ST Express services, generally use First Avenue S. and penetrate the downtown area through the Pioneer Square district. Existing bus transit routes using the AWV to access downtown are shown in Exhibit 5-43.

5.4.1 Transit Vehicle Connections

MOE T1: Transit Connections

Key Findings

- Transit connections will continue to be provided to northbound and from southbound SR 99 at the Denny ramps under each of the alternatives.
- The Rebuild and Aerial Alternatives could continue providing access into downtown at the Seneca Street off-ramp and from downtown at the Columbia Street on-ramp. Alternatively, with the addition of the Atlantic Street ramps, some transit services could be rerouted to access downtown via Fourth Avenue from the stadium area. These routes will experience longer travel times, but will also provide greater coverage and serve a wider area of downtown.
- Transit agencies have indicated that service would likely use the new Atlantic Street ramps and Fourth Avenue to access downtown. As with the other alternatives, the option to more directly access downtown exists as well. Under the Tunnel or Bypass Tunnel Alternatives, the King Street ramps could provide transit access to Alaskan Way and on into downtown. The mainline under the Surface Alternative will provide connections directly into downtown at Yesler Way and the next several intersections north on Alaskan Way. Congestion on SR 99 may limit the suitability of these connections, however.



0 2,500
SCALE IN FEET

N

Exhibit 5-43
Potential SR 99 Bus Transit Connections
2030 Existing Facility

This section discusses the functionality of transit connections for each of the Build Alternatives. Each alternative is evaluated to determine how the proposed Build Alternative would provide or improve transit vehicle connections in comparison to the existing facility.

2030 Existing Facility

The 2030 Existing Facility scenario will continue to provide existing transit connections. Potential bus transit connections are shown in Exhibit 5-43. Transit vehicles that currently use the ramps at Seneca Street and Columbia Street will continue to use those ramps. Transit vehicles to and from the north will continue to use the ramps at Denny Way.

Rebuild Alternative

The Rebuild Alternative will continue to provide existing transit connections, as well as full access at SR 519. Potential bus transit connections are shown in Exhibit 5-44. Transit vehicles that currently use the ramps at Seneca Street and Columbia Street may continue to use those ramps. King County Metro has expressed some interest in reorienting express transit service from the south end to the stadium area exits (S. Atlantic Street and S. Royal Brougham Way). This will allow King County Metro to utilize the Fourth Avenue S. corridor, thereby serving expanding employment centers at the Union Station area. Transit vehicles to and from the north will continue to use the ramps at Denny Way.

Aerial Alternative

The Aerial Alternative will continue to provide existing transit connections, as well as full access at SR 519. Potential bus transit connections are shown in Exhibit 5-44. Transit vehicles that currently use the ramps at Seneca and Columbia Streets may continue to use those ramps. King County Metro has expressed some interest in reorienting express transit service from the south end to the stadium area exits (S. Atlantic Street and S. Royal Brougham Way). This would allow King County Metro to utilize the Fourth Avenue S. corridor, thereby serving expanding employment centers in the Union Station area. Transit vehicles to and from the north will continue to use the ramps at Denny Way.

Tunnel Alternative

The Tunnel Alternative will not include ramps at Seneca and Columbia Streets. Potential bus transit connections are shown in Exhibit 5-45. Transit vehicles traveling on the AWV to and from the south will access downtown via the new ramps located at SR 519, and then travel north on either First

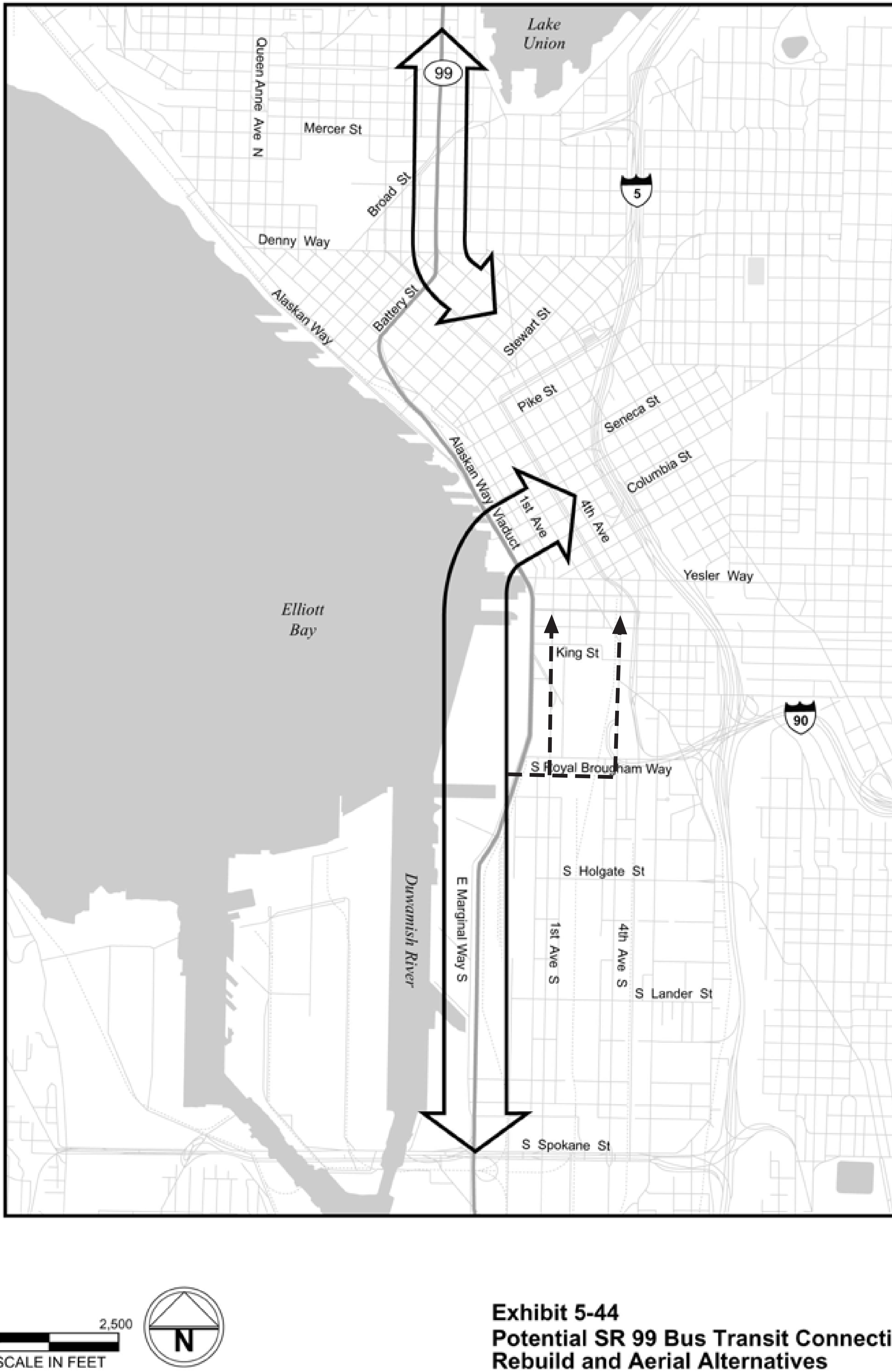


Exhibit 5-44
Potential SR 99 Bus Transit Connections - Rebuild and Aerial Alternatives

Avenue or Fourth Avenue. They will also have the option of accessing the midtown area via the King Street ramps and Alaskan Way on the waterfront. Transit access to the midtown area to and from the south will be slower than in the 2030 Existing Facility scenario, as transit vehicles will be using arterials to reach midtown starting from the SR 519 area. However, those transit vehicles will also be serving a larger area of downtown than they currently serve, potentially increasing ridership on those routes and providing increased transit service to the south downtown area. To and from the north, transit vehicles will continue to use the ramps at Denny Way. Transit connections to and from the north will generally be very similar to the 2030 Existing Facility scenario. The King Street ramps do not seem to be preferable for transit use for downtown connections.

Bypass Tunnel Alternative

The Bypass Tunnel Alternative will not include ramps at Seneca and Columbia Streets. Potential bus transit connections are shown in Exhibit 5-45. Transit vehicles traveling on the AWV to and from the south will access downtown via the new ramps located at SR 519, and then travel north on either First Avenue or Fourth Avenue. They will also have the option of accessing the midtown area via Alaskan Way on the waterfront. Transit access to the midtown area to and from the south will be slower than in the 2030 Existing Facility scenario, as transit vehicles will be using arterials to reach midtown starting from the SR 519 area. However, those transit vehicles will also be serving a larger area of downtown than they currently serve, potentially increasing ridership on those routes and providing increased transit service to the south downtown area. As with the Tunnel Alternative, transit vehicles will continue to use the ramps at Denny Way. Transit connections to and from the north will generally be very similar to the 2030 Existing Facility scenario.

Surface Alternative

The Surface Alternative will not include ramps at Seneca and Columbia Streets. However, as the mainline will be on Alaskan Way, access into and out of downtown will be available at all cross streets along the waterfront. Therefore, transit vehicles to and from the south will be able to continue to enter at Seneca and exit at Columbia, or use other streets if those work better. A wider range of options for accessing the midtown will be made available with the mainline on Alaskan Way surface street. However, travel times in and out of the midtown are anticipated to be longer due to the anticipated increase in traffic volumes. Potential bus transit connections are

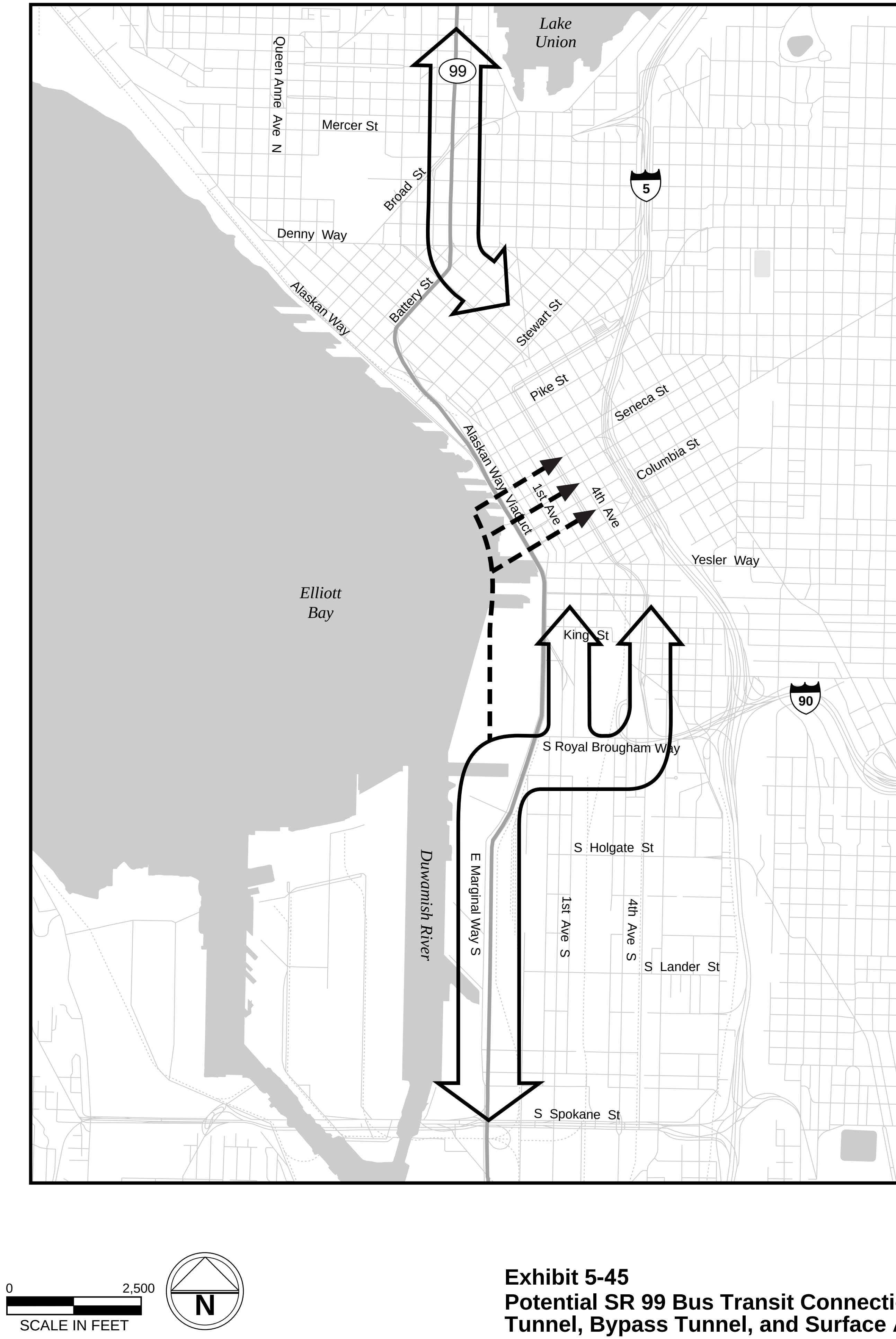


Exhibit 5-45
Potential SR 99 Bus Transit Connections - Tunnel, Bypass Tunnel, and Surface Alternatives

shown in Exhibit 5-45. To and from the north, transit vehicles will continue to use the ramps at Denny Way. Transit connections to and from the north will generally be very similar to the 2030 Existing Facility scenario.

5.4.2 Peak Hour Travel Times

MOE T2: Transit Travel Times and Coverage Area

<u>Key Findings</u>

- Transit travel times under the Rebuild, Aerial, Tunnel, and Bypass Tunnel Alternatives will be similar to the 2030 Existing Facility scenario, should direct routing into downtown continue to be utilized to and from the south (via the Columbia and Seneca Street ramps or the King Street ramps).
- Transit routing to and from the south could instead be accommodated by the new Atlantic Street ramps, SR 519, and Fourth Avenue under any of the alternatives. This route would increase travel times compared to the 2030 Existing Facility scenario, but would allow service to more locations downtown and in the stadium area. Also, this routing would be subject to traffic congestion in the stadium area during events.
- The Surface Alternative is forecast to increase travel times for buses using SR 99 or local streets downtown due to reduced roadway capacity increased congestion. Increased use of transit corridors (such as the E3 busway), or implementation of transit priority systems could potentially partially offset the effect of increased congestion on bus services.
- The Seattle Monorail Project will provide grade-separated transit service along the corridor, which will not be affected by traffic conditions under any of the alternatives.

This section includes an evaluation of the potential impact of each alternative on peak hour transit travel times. Specific travel time estimates for transit routes are not presented, as the number of outside variables affecting future transit travel times is high. Instead, the focus is on the relative, general effect each alternative will have on transit performance.

Peak hour transit travel times are dependent on a number of factors, including roadway operating conditions, routing, the number of transit stops served, and headways (which dictate the average amount of time transit patrons have to wait to catch transit service). The project alternatives could primarily influence transit travel times by creating changes in roadway operating conditions or by introducing changes in bus routing. These two factors are explored in this analysis. For each of the Build Alternatives, potential transit travel time impacts of relevant roadway operational results and routing changes (as described in the previous section) are explored.

2030 Existing Facility

Transit services that currently use the SR 99 corridor include routes that use the corridor south of Seattle and access downtown at the existing Seneca Street and Columbia Street ramps. Bus routes to and from West Seattle (current routes 20, 21, 54, 55, and 56E) and communities south of Seattle (bus routes 113, 130E, 132E, and 135) use this section of the corridor. In the north, bus routes to and from Ballard and Greenwood (routes 5 and 28E) and north Seattle (route 358) access downtown via the Denny Way ramps. Future transit service is expected to mirror current service, though Seattle Monorail service is anticipated to replace some West Seattle and Ballard routes in providing access to downtown. Local routes from these areas, as well as routes from other areas south and north of downtown Seattle, would likely continue to use the SR 99 corridor to access downtown. As a grade-separated guideway system, monorail travel times will not be affected by SR 99 alternatives.

Current transit travel times, as well as those that would be experienced under the 2030 Existing Facility scenario, vary by route. Traffic conditions on SR 99 influence these travel times. As identified in Section 5.3.2, vehicle travel times into downtown from the south corridor are estimated at 10 minutes (from the Spokane Street bridge), compared to 8 minutes currently. Leaving downtown, 2030 vehicle travel times are estimated to remain at roughly 9 minutes (to the Spokane Street bridge). In the north corridor, vehicle travel times into downtown Seattle (from the Aurora Bridge) are forecasted to increase modestly from existing travel times (16 minutes in 2030, versus 15 minutes currently). Outbound travel times are forecasted to increase from 11 to 12 minutes in 2030. Actually, bus travel times could exceed these based on routing and the frequency of stops provided. However, excepting changes in routing or service characteristics that could be introduced independently by the transit agencies, 2030 bus travel times under the 2030 Existing Facility scenario would be affected only minimally by changes in roadway operating conditions on the SR 99 corridor.

Rebuild Alternative

For the Rebuild Alternative, transit travel times are generally anticipated to be similar to those in the 2030 Existing Facility scenario, presuming routing changes are not instituted by the transit agencies. Should transit vehicles continue to use the same routes as today to access downtown, no notable differences in travel times would be expected. Alternatively, transit routes to and from the south could access downtown via the new Atlantic Street ramps, SR 519, and Fourth Avenue. This routing would increase travel times (an undetermined amount that is dependent on the number of transit stops provided), but would provide greater coverage area in the downtown as a trade-off. Also, this routing would be subject to traffic congestion in the stadium area during events.

Transit travel times for other bus routes using local streets downtown are not expected to be affected by the Rebuild Alternative relative to the 2030 Existing Facility scenario, as traffic volumes and intersection operations downtown will be similar to 2030 Existing Facility conditions.

Aerial Alternative

For the Aerial Alternative, transit travel times and issues are essentially equivalent to those provided under the Rebuild Alternative.

Tunnel Alternative

As with the Aerial and Rebuild Alternatives, the Tunnel Alternative will have minimal effect on transit travel times if routing uses the King Street ramps to provide access into downtown. As shown in Section 5.3.2, travel times into and out of downtown under the Tunnel Alternative will be similar to or better than those under the 2030 Existing Facility scenario or other Build Alternatives.

King County Metro has expressed interest in consideration of routing transit services via the new Atlantic Street ramps, SR 519, and Fourth Avenue into downtown, rather than using the King Street ramps. In this case, the expected travel times would be longer than the current routing (due to a longer route over local streets) and would be variable depending on the number of new stops introduced. While involving longer travel times, this routing would provide access to a greater area of downtown, and could potentially serve more riders. This routing would however be subject to traffic congestion in the stadium area during events.

Travel times for other transit vehicles in the downtown area are anticipated to be similar or even slightly improved to those under 2030 Existing Facility conditions, as traffic operations on downtown streets are expected to improve modestly under the Tunnel Alternative.

Bypass Tunnel Alternative

For the Bypass Tunnel Alternative, the same routing opportunities as described for the Tunnel Alternative will be possible. Travel times will be similar or slightly longer to and from downtown under the Bypass Tunnel Alternative, as vehicle travel times projected in Section 5.3.2 are generally 1 or

2 minutes longer for the Bypass Tunnel Alternative than for the Tunnel Alternative. As with the Tunnel Alternative, routing instead via the new S. Atlantic Street ramps, SR 519, and Fourth Avenue would result in longer travel times, and would be subject to congestion in the stadium area, but would provide access to a greater portion of downtown and could potentially serve more riders.

Surface Alternative

For the Surface Alternative, transit travel times are anticipated to be greater than for the 2030 Existing Facility scenario or other Build Alternatives, due to increased corridor and system congestion and reduced roadway capacities. Bus routes will have the same access options as under the Tunnel or Bypass Tunnel Alternatives, though access into downtown along Alaskan Way will result in substantial increases in expected travel times. As shown in Section 5.3.2, travel times into downtown Seattle from the south on SR 99 are expected to double under the Surface Alternative (20 minutes, compared to 10 minutes), while trips leaving downtown to the south will be less affected (10 minutes compared to 8 under the 2030 Existing Facility). Routing into town on SR 519 and Fourth Avenue may be more competitive given the longer direct travel times along Alaskan Way, but will still be longer compared to the current routing. As with the other alternatives, an advantage of the SR 519 and Fourth Avenue routing is greater coverage in the downtown area, while a drawback is event congestion in the stadium area.

Some increase in travel times could be expected under the Surface Alternative for all downtown bus routes, unless measures to give transit priority are implemented. This is due to higher traffic volumes and increased congestion on downtown streets. The City of Seattle's policy is to give transit priority in the downtown area and measures to maintain transit speed and reliability would likely be implemented if downtown streets became more congested. Increased utilization of transit facilities that provide travel time advantages, such as the E3 busway, could help avoid increased congestion on some surface streets, while implementation of transit priority systems could help reduce the effect of traffic congestion on bus routes on the arterial grid.

The Seattle Monorail will provide transit service along the SR 99 corridor that will be unaffected by the roadway conditions forecasted under the Surface Alternative. Monorail riders from the Ballard and West Seattle areas will not experience increased travel times under the Surface Alternative.

5.4.3 HCT, HOV, and Enhanced Bus Service

MOE T3: Impact to Development of Future High-Capacity Transit and High-Occupancy Vehicle Use Through the Corridor

Key Findings

- The Build Alternatives will have minimal impacts on future HCT systems (i.e., light rail, commuter rail, and monorail) operating in downtown Seattle due to the grade separation and somewhat distant location of operating rights-of-way. Increased downtown traffic from the Surface Alternative may result in increased conflicts for pedestrians accessing downtown monorail stations, especially those along Second Avenue.
- HOV facilities function best when there is traffic congestion in adjacent general-purpose lanes. For all Build Alternatives, excluding the Surface Alternative, SR 99 mainline congestion is forecasted to be minimal or localized (in spot locations),. Providing for an additional lane in each direction dedicated to HOV lanes will be difficult and costly, as right-of-way is limited in many critical sections in the corridor. Further, due to design constraints, it will be difficult to maintain HOV lane continuity throughout the corridor, which will place a disincentive to form HOVs or take transit as travel time savings degrade when HOV and transit vehicles are forced to merge with general-purpose traffic. HOV lanes for the Surface Alternative may be ineffective, as buses, carpools, and vanpools will encounter increased congestion on signalized arterials similar to that experienced by single occupant vehicles, thereby reducing the incentive for travelers to form HOVs or take transit.
- Bus service can be enhanced by providing improved access treatments at the south and north ends of the corridor. These could be in the form of transit signal priority and exclusive transit/HOV queue bypass lanes and ramps. For those alternatives that will not have midtown access directly from SR 99 (at the Seneca and Columbia ramps), transit agencies may prefer that south-end transit trips egress and access the corridor at S. Atlantic Street and S. Royal Brougham Way, rather than at King Street and Alaskan Way. This will allow for greater penetration of the south downtown area for transit patrons.

This MOE qualitatively discusses the potential physical conflicts with proposed HCT alignments, the potential for future HOV or HCT use in the corridor under the proposed Build Alternative, and the ability of an alternative to facilitate enhanced bus transit service.

Summary

High-Capacity Transit

As has been noted above, the Alaskan Way Viaduct (SR 99) Corridor provides important transit access for bus transit trips to and from the south of downtown Seattle. By 2030, the nature of transit service in the downtown Seattle area will have changed dramatically with the advent of Sound Transit's Link light rail and Sounder commuter rail services, and the Seattle Monorail Project's Green Line. In addition, regional and local bus service and local streetcar systems are anticipated to grow to meet the demands of transit patrons traveling to and within downtown Seattle. These transit services may also be supplemented with bus rapid transit facilities and services if the region chooses to implement them.

The majority of HCT investments will be located, for the most part, in the core of the downtown area, or between Second Avenue and Fourth Avenue, with the largest HCT facilities being the Downtown Seattle Transit Tunnel and the Seattle Monorail Green Line. The Downtown Seattle Transit Tunnel operates predominantly under Third Avenue through the downtown core area, curving northeast after University Street until it reaches the Convention Center station at Ninth Avenue and Pine Street. Beginning in 2009, both buses and trains will be jointly operating in the tunnel. By 2030, it is anticipated that light rail trains will be operating exclusively in the tunnel. Traffic impacts from the five Build Alternatives should not affect bus tunnel operations due to the tunnel exclusive right-of-way.

The Sounder commuter rail service should also see minimal impacts from any of the five Build Alternatives as it operates on the BNSF mainline railroad tracks.

The Seattle Monorail Project's Green Line will also travel through the core of the downtown area. According to the Seattle Monorail Project Draft EIS, the monorail structures will be placed along Fifth Avenue from Broad Street to Stewart Street, then travel from there to Second Avenue to S. Jackson Street. From there it will travel south just past the King Street Station and just west of Fourth Avenue S. to approximately S. Lander Street/First Avenue and parts south, ultimately to West Seattle via S. Spokane Street.

Based on these draft alignments, none of the SR 99 alternatives, with the exception of the Surface Alternative, will produce traffic impacts that will severely affect on-street patrons seeking to access the monorail stations. Traffic analysis has shown that traffic distribution to the north–south arterials in the downtown area will be higher under the Surface Alternative, which will increase delay and congestion at downtown intersections. With increased pedestrian traffic accessing downtown stations from the street level, there could be more impacts with pedestrians under the Surface Alternative.

Providing for an additional lane in each direction dedicated to HOV lanes will be difficult and costly, as right-of-way is limited in many critical sections in the corridor. For example, acquiring right-of-way in the south end will require incursions into the BNSF rail yards. Further, due to design constraints, it will be difficult to maintain HOV lane continuity throughout the corridor, which will place a disincentive to form HOVs or take transit as travel time savings degrade when HOV and transit vehicles are forced to merge with general-purpose traffic. . .

Because of inherent capacity constraints north and south of the corridor, vehicle traffic is effectively reduced. In the north, the Battery Street Tunnel, with two lanes in each direction, helps to discourage traffic from using the SR 99 corridor, especially for long-distance trips. In the south, signalized intersections north of the First Avenue S. Bridge and lower posted speed limits provide a disincentive for long-distance trips to bypass I-5 and use the SR 509/SR 99 corridor to get to downtown Seattle. The AWV Corridor is generally difficult to reach from regional freeways.

Where congestion does occur, at ramps providing access/egress from SR 99, there are possibilities to enhance travel time savings for transit and HOVs. These can be in the form of short, exclusive HOV by-pass lanes, and transit signal priority measures. These two strategies have been included in the definition of all plan alternatives. Future detailed designs for the Preferred Alternative will look more closely at how these strategies will work in the corridor.

Enhanced Bus Service

For the Rebuild and Aerial Alternatives, King County Metro staff has indicated that transit vehicles accessing downtown Seattle from the south would use the midtown ramps at Seneca and Columbia Streets. However, for the Tunnel and Bypass Tunnel Alternatives, Metro transit staff has indicated that, rather than use ramps located at King Street, in-bound buses from the south not truncating at outlying monorail stations would most likely exit at S. Atlantic Street and head east to Fourth Avenue S. From there, they would travel north serving Union Station area jobs before traveling north into the downtown area. For transit patrons from West Seattle and the south end who work in the south and central downtown areas, this reorientation of transit would provide greater accessibility and possible travel time savings. Finally, for the Surface Alternative, buses will be able to enter the midtown via multiple east–west streets along Alaskan Way.

For all alternatives, proposals to provide transit signal priority at the S. Atlantic Street/S. Royal Brougham Way and First Avenue intersections may enhance transit speed and reliability. Transit signal priority and possible queue jump lanes, along with enhancements in the north end for buses accessing/exiting Aurora Avenue N. from Denny Way, will also enhance bus rapid transit operations. These strategies are still being considered as part of the flexible transportation package and will be refined in final design of the Preferred Alternative.

Rebuild Alternative

High-Capacity Transit

No general operational conflicts with planned HCT investments are expected with this alternative. This includes Sound Transit's Link light rail and Sounder commuter rail and the Seattle Monorail Project.

As traffic mitigation plans for the Rebuild Alternative are developed, construction will need to be coordinated with the Seattle Monorail Project and Sound Transit tunnel conversion projects, as construction schedules may run concurrently.

HOV Facilities

Providing for an additional lane in each direction dedicated to HOV lanes would be difficult and costly, as right-of-way is limited in many critical sections in the corridor. Further, due to design constraints, it will be difficult to maintain HOV lane continuity throughout the corridor, which will place a disincentive to form HOVs or take transit as travel time savings degrade when HOV and transit vehicles are forced to merge with general-purpose traffic or cause traffic to divert to local arterials and/or I-5. Congestion at ramps, though, is probable, and such treatments as HOV queue bypass lanes may reduce delay at ramp termini and adjoining intersections.

Enhanced Bus Service

The Rebuild Alternative will retain access ramps serving transit trips to and from the south at Columbia and Seneca Streets. This will provide for continued penetration of the midtown area by bus transit. In-bound transit patrons coming from the south will still be required to transfer to other routes or walk to their destinations as in today's conditions. Also, provisions to provide transit signal priority at the S. Atlantic Street/S. Royal Brougham Way and First Avenue intersections may enhance bus rapid transit speed and reliability. Transit signal priority and possible queue bypass lanes, along with enhancements in the north end for buses accessing/exiting Aurora Avenue N. from Denny Way, will also enhance bus rapid transit operations. These strategies are still being considered as part of the flexible transportation package and will be refined in final design of the Preferred Alternative.

Aerial Alternative

High-Capacity Transit

No general operational conflicts with planned HCT investments are expected with this alternative. This includes Sound Transit's Link light rail and Sounder commuter rail and the Seattle Monorail Project's Green Line.

The development of traffic mitigation plans for the any of the Build Alternatives' construction will need to be coordinated with the Seattle Monorail Project and Sound Transit tunnel conversion projects, as portions of construction schedules may run concurrently.

HOV Facilities

The Aerial Alternative presents the most flexibility of all the alternatives to introduce bi-directional HOV lanes, as there will be adequate right-of-way on the aerial structure to restripe the facility, if desired at a future date. However, providing for an additional HOV lane in each direction in the south end will be difficult and costly, as acquiring right-of-way in the south end will require incursions into the BNSF rail yards. Still, because of capacity constraints at the Battery Street Tunnel in the north and at the First Avenue S. bridge area in the south, it is projected that these lanes would not be needed by 2030. Congestion at ramps, though, is probable, and such treatments as HOV queue bypass lanes may reduce delay at ramp termini and adjoining intersections.

Enhanced Bus Service

Arterial intersections in the Elliott/Western corridor operate somewhat poorly in comparison to the 2030 Existing Facility and other alternatives. Bus service traveling in this corridor may encounter higher congestion levels due to reduced levels of service. Provisions to provide transit signal priority at the S. Atlantic Street/S. Royal Brougham Way and First Avenue intersections may enhance transit speed and reliability. Transit signal priority and possible queue jump lanes, along with enhancements in the north end for buses accessing/exiting Aurora Avenue N. from Denny Way, will also enhance rapid transit operations. These strategies are still being considered as part of the flexible transportation package and will be refined as final design proceeds after selection of the Preferred Alternative.

Tunnel Alternative

High-Capacity Transit

No general operational conflicts with planned HCT investments are expected with this alternative. This includes Sound Transit's Link light rail and Sounder commuter rail and the Seattle Monorail Project.

Given the distance from the downtown transit tunnel, there should be limited effects on light rail transit operations. During construction, possible impacts to traffic may occur, especially during the period when tunnel buses need to be moved to the surface during tunnel conversion activities for light rail. The tunnel is expected to be under construction from 2007 to 2009, though this is subject to change.

Like all the Build Alternatives, construction mitigation for traffic for the Tunnel Alternative will need to be coordinated with the Seattle Monorail and Sound Transit tunnel conversion projects, as portions of these projects' construction may run concurrently.

HOV Facilities

Providing for an additional lane in each direction dedicated to HOV lanes would be difficult and costly, as right-of-way is limited in many critical sections in the corridor. Further, due to design constraints, it will be difficult to maintain HOV lane continuity throughout the corridor, which will place a disincentive to form HOVs or take transit as travel time savings degrade when HOV and transit vehicles are forced to merge with general-purpose traffic. Bi-directional HOV lanes in the tunnel would likely reduce capacity and increase delay for vehicles during the peak travel periods. Congestion at ramps, though, is probable, and such treatments as HOV queue bypass lanes may reduce delay at ramp termini and adjoining intersections.

Enhanced Bus Service

King County Metro staff has indicated that, rather than use ramps located at King Street, in-bound buses from the south not truncating at outlying monorail stations would exit at S. Atlantic Street and head east to Fourth Avenue S. From there, they would travel north serving Union Station area jobs before traveling north into the downtown area. For transit patrons from West Seattle and the south end who work in the southern and central downtown areas, this reorientation of transit would provide greater accessibility and possible travel time savings.

Provisions to provide transit signal priority at the S. Atlantic Street/S. Royal Brougham Way and First Avenue intersections may enhance bus rapid transit speed and reliability. Transit signal priority and possible queue jump lanes, along with enhancements in the north end for buses accessing/exiting Aurora Avenue N. from Denny Way, will also enhance bus rapid transit operations. These strategies are still being considered as part of the flexible transportation package and will be refined in final design of the Preferred Alternative.

Bypass Tunnel Alternative

High-Capacity Transit

No general operational conflicts with planned HCT investments are expected with this alternative. This includes Sound Transit's Link light rail and Sounder commuter rail and the Seattle Monorail Project's Green Line.

Traffic mitigation plans for the Bypass Tunnel Alternative construction will need to be coordinated with Monorail Green Line and Sound Transit tunnel conversion projects, as construction schedules may run concurrently.

HOV Facilities

Providing for an additional lane in each direction dedicated to HOV lanes would be difficult and costly, as right-of-way is limited in many critical sections in the corridor. Further, due to design constraints, it will be difficult to maintain HOV lane continuity throughout the corridor, which will place a disincentive to form HOVs or take transit as travel time savings degrade when HOV and transit vehicles are forced to merge with general-purpose traffic. Bi-directional HOV lanes in the Bypass Tunnel would severely reduce vehicle capacity, causing increased delay for vehicles during the peak travel periods. This is especially crucial as the Bypass Tunnel Alternative, unlike the Tunnel Alternative, will operate with only two lanes in each direction, whereas the Tunnel Alternative will operate with three lanes in each direction. Congestion at ramps, though, is probable, and such treatments as HOV queue bypass lanes may reduce delay at ramp termini and adjoining intersections.

Enhanced Bus Service

King County Metro staff has indicated that, rather than use ramps located at King Street, in-bound buses from the south not truncating at outlying monorail stations would exit at S. Atlantic Street and head east to Fourth Avenue S. From there, they would travel north serving Union Station area jobs before traveling north into the downtown area. For transit patrons from West Seattle and the south end who work in the southern and central downtown areas, this reorientation of transit would provide greater accessibility and possible travel time savings.

Proposals to provide transit signal priority at the S. Atlantic Street/S. Royal Brougham Way and First Avenue intersections may enhance rapid transit speed and reliability. Transit signal priority and possible queue jump lanes, along with enhancements in the north end for buses accessing/exiting Aurora Avenue N. from Denny Way, will also enhance rapid transit operations. These strategies are still being considered as part of the flexible transportation package and will be refined as part of the final design of the Preferred Alternative.

Surface Alternative

High-Capacity Transit

No general operational conflicts with planned HCT investments are expected with this alternative. This includes Sound Transit's Link light rail and Sounder commuter rail and the Seattle Monorail Project's Green Line.

During construction, traffic mitigation plans will need to be coordinated with the Seattle Monorail Project, as project construction schedules may overlap for some period of time.

Rapid transit services that will use downtown Seattle north–south arterials will encounter increased traffic as capacity along Alaskan Way is reduced and auto traffic diverts to these downtown arterials and I-5.

Bicycles and pedestrians accessing downtown HCT stations and stops will encounter higher levels of on-street traffic.

HOV Facilities

Providing for an additional lane in each direction dedicated to HOV lanes would be difficult and costly, as right-of-way is limited in many critical sections in the corridor. Further, due to design constraints, it will be difficult to maintain HOV lane continuity throughout the corridor, which will place a disincentive to form HOVs or take transit as travel time savings degrade when HOV and transit vehicles are forced to merge with general-purpose traffic.

Signalized intersections along Alaskan Way and lower arterial travel times would reduce the benefits of a corridor HOV facility in this area. In addition, a bi-directional exclusive HOV lane in the corridor will reduce capacity, thereby increasing congestion further. Bus transit vehicles will likely access and egress the SR 99 facility upstream at S. Atlantic Street and S. Royal Brougham Way, bypassing the congested Alaskan Way corridor, and more importantly, providing downtown core transit service closer to where patrons wish to go, i.e., Fourth Avenue for northbound trips and Second Avenue for southbound trips.

Enhanced Bus Service

The Surface Alternative will not include ramps at Seneca and Columbia Streets. However, as the mainline will be on Alaskan Way, access into and out of downtown will be available at all cross streets along the waterfront. Therefore, transit vehicles to and from the south will be able to continue to enter at Seneca and exit at Columbia, or use other streets if those work better. A wider range of options for accessing the midtown will be made available with the mainline on Alaskan Way surface street. However, travel times in and out of the midtown are anticipated to be greater due to the anticipated increase in traffic volumes.

Provisions to provide transit signal priority at the S. Atlantic Street/S. Royal Brougham Way and First Avenue intersections may enhance bus rapid transit speed and reliability. Transit signal priority and possible queue jump lanes, along with enhancements in the north end for buses accessing/exiting Aurora Avenue N. from Denny Way, will also enhance bus rapid transit operations. These strategies are still being considered as part of the flexible transportation package and will be refined in final design of the Preferred Alternative.

5.5 Freight

MOE FT1: Impact to Freight Mobility and Operations

Key Findings

- Freight connections between SR 99, SR 519, and the waterfront will be improved in all alternatives other than the 2030 Existing Facility.
- Freight connections to and from the BINMIC area will be degraded in the Bypass Tunnel and Surface Alternatives, as trucks will be required to travel on Alaskan Way surface street through downtown Seattle.
- Travel times for the two primary freight routes are improved or similar compared to the 2030 Existing Facility for all alternatives except the Bypass Tunnel Alternative (Ballard/Interbay trips) and the Surface Alternative (Ballard/Interbay trips and SR 99 through trips).
- All Build Alternatives will include improved lane widths and shoulders south of the Battery Street Tunnel.
- The ramps at Seneca and Columbia Streets, which are currently poorly suited for truck use, will either be improved or access will be provided through new connections in all Build Alternatives except the Rebuild Alternative.
- The Alaskan Way surface street is expected to experience an increase in truck volumes under the Bypass Tunnel and Surface Alternatives.

5.5.1 Effect on Freight Connections

2030 Existing Facility

Duwamish/Harbor Island/SR 519 Connections

The 2030 Existing Facility scenario provides connections between SR 99 and the waterfront via the First Avenue S. ramps (via S. Royal Brougham Way or Atlantic Street, and First Avenue S. These ramps also provide access from SR 519 to the SR 99 corridor. Access to SR 99 is provided only to and from the north. Freight trips to/from the south in this location use E. Marginal Way or other arterial routes.

SR 99 is grade separated over S. Royal Brougham Way and S. Atlantic Street, and therefore does not interfere with freight movements from E. Marginal Way or the waterfront to SR 519 or the BNSF SIG rail-yard. The tail track from the BNSF SIG rail yard impacts some truck movements, as described in Section 5.5.4.

BINMIC Area

For the 2030 Existing Facility scenario, the primary truck route between the SR 99 corridor and the BINMIC area is the Western/Elliott ramps and couplet, and 15th Avenue W. The Western/Elliott couplet travels directly through the Belltown area, which is densely populated with residential and commercial development. Freight operations can be affected by vehicle and pedestrian activity in this area, particularly at the ramp locations. Likewise, the presence of heavy freight vehicles on the corridors is a disturbance to the existing land uses.

An alternative route to or from the BINMIC area is along the surface street Alaskan Way. This route may be used by vehicles prohibited on the AWV (such as hazardous materials or oversized vehicles), or in cases of severe congestion on SR 99. Similar to the Western/Elliott couplet, adjacent land uses are not highly compatible with heavy freight use. Additionally, this route is generally slower than the primary route on Western or Elliott Avenue.

Rebuild Alternative

Duwamish/Harbor Island/SR 519 Connections

The Rebuild Alternative will provide improved connections to the Duwamish area and SR 519. The Rebuild Alternative will replace the First Avenue S. ramps with a full interchange at SR 519 (S. Atlantic St. and S. Royal Brougham Way). This interchange configuration will provide more direct access to the SR 99 corridor, as well as new access to and from the south. The new interchange, including S. Royal Brougham Way and S. Atlantic Street, will be grade-separated over SR 99, and therefore freight movements from E. Marginal Way or the waterfront to SR 519 or the BNSF SIG rail-yard will not be impeded. Under this configuration, freight movements would also be unaffected by switching operations on the tail track from the BNSF SIG rail yard (see Section 5.5.4). The raised interchange configuration will introduce some grades on freight routes between the waterfront and First Avenue S. (up to approximately 8%). A design option to instead grade-separate SR 99 over the local connections (which would remain at grade) could be implemented instead. This option is described below for the Aerial Alternative.

BINMIC Area

The Rebuild Alternative will maintain the same connections to the BINMIC area as provided by the existing facility.

Aerial Alternative

Duwamish/Harbor Island/SR 519 Connections

The Aerial Alternative will provide improved connections to the Duwamish area and SR 519. This alternative will replace the First Avenue S. ramps with a full interchange at SR 519 (S. Atlantic St. and S. Royal Brougham Way). This interchange configuration will provide more direct access to the SR 99 corridor, as well as new access to and from the south. SR 99 would be grade-separated over the new interchange, S. Royal Brougham Way and S. Atlantic Street. Because the local streets remain at-grade, some freight movements would be affected by switching operations on the BNSF SIG rail yard tail track. Local streets would not be subject to new grades, though the ramps to/from SR 99 would approach 8%. The raised interchange described for the Rebuild Alternative could be constructed instead as a design option instead of the at-grade interchange.

BINMIC Area

The Aerial Alternative will maintain the same connections to the BINMIC area as provided by the existing facility.

Tunnel Alternative

Duwamish/Harbor Island/SR 519 Connections

The Tunnel Alternative will provide improved connections to the Duwamish area and SR 519. This alternative will replace the First Avenue S. ramps with a full interchange at SR 519 (S. Atlantic St. and S. Royal Brougham Way). This interchange configuration will provide more direct access to the SR 99 corridor, as well as new access to and from the south. The new interchange, including S. Royal Brougham Way and S. Atlantic Street, will be grade-separated over SR 99, and therefore freight movements from E. Marginal Way or the waterfront to SR 519 or the BNSF SIG rail-yard will not be impeded. Under this configuration, freight movements would also be unaffected by switching operations on the tail track from the BNSF SIG rail yard (see Section 5.5.4). The raised interchange configuration will introduce some grades on freight routes between the waterfront and First Avenue S. (up to approximately 7%). A design option to instead grade-separate SR 99 over the local connections (which would remain at grade) could be implemented instead. This option was described previously for the Aerial Alternative.

BINMIC Area

The Tunnel Alternative will replace the Elliott and Western ramps with new ramps to Alaskan Way north of Pike Street. In conjunction with the proposed new undercrossing of the BNSF tracks near Broad Street (connecting Alaskan Way to Elliott Avenue), this configuration would maintain similar connectivity as provided by the existing facility. Similar issues regarding conflicts with adjacent land uses on Alaskan Way would be expected as are currently experienced on the Elliott and Western couplet for the existing facility. Additionally, this connection is expected to experience very high congestion levels in the vicinity of the BNSF undercrossing. As a design option, ramps could instead be constructed to the Elliott and Western couplet, similar to as described for the previous alternatives.

Bypass Tunnel Alternative

Duwamish/Harbor Island/SR 519 Connections

The Bypass Tunnel Alternative will provide improved connections to the Duwamish area and SR 519 similar to those described under the Rebuild and Tunnel Alternative.

BINMIC Area

For the Bypass Tunnel Alternative, the AWV will not include ramps between SR 99 and the local street system north of King Street. Instead, trucks will have to use a less direct route, exiting at King Street and using the Alaskan Way surface street through downtown. Alternatively, trucks could continue on the corridor through the Battery Street Tunnel and access the BINMIC area through South Lake Union (lower Queen Anne) or Fremont. A design option to construct a new arterial between Alaskan Way and the Elliott/Western couplet could be constructed, providing an alternate to the BNSF undercrossing route.

Surface Alternative

Duwamish/Harbor Island/SR 519 Connections

The Surface Alternative will provide improved connections to the Duwamish area and SR 519 similar to those described under the Rebuild, Tunnel, and Bypass Tunnel Alternatives.

BINMIC Area

For the Surface Alternative, the primary truck route serving the BINMIC area will continue to be via the Elliott/Western couplet and 15th Avenue W. An additional route would be also be provided by the Alaskan Way surface street and undercrossing of the BNSF railroad at Broad Street. Access to these routes will be more difficult than under other alternatives, however, since the SR 99 mainline is a surface arterial (Alaskan Way) through the highly congested waterfront area.

5.5.2 Freight Travel Times

The impact of each alternative on truck/freight travel time is presented in this section. Travel times directly relate to the evaluation of connections presented above. For the purpose of this analysis, two freight routes are considered: a through route from the Aurora Bridge to Spokane Street, and a BINMIC route from the Ballard Bridge to SR 519. This represents the two major freight corridors in the study area for which travel time data is available. Year 2030 travel times for the PM peak hour are presented in Exhibit 5-15.

2030 Existing Facility

As shown in Exhibit 5-15, for the 2030 Existing Facility scenario, the year 2030 PM peak hour travel time for traffic traveling between the Aurora Bridge and Spokane Street will be about 9 minutes in the southbound direction and about 12 minutes in the northbound direction. Travel time between the Ballard Bridge and SR 519 will be about 13 minutes in the southbound direction and 19 minutes in the northbound direction.

Rebuild Alternative

As shown in Exhibit 5-15, for the Rebuild Alternative the PM peak hour travel time for traffic traveling between the Aurora Bridge and Spokane Street will be about the same as in the 2030 Existing Facility in the southbound direction (9 minutes). In the northbound direction, travel time will be slightly less than in the 2030 Existing Facility scenario (9 minutes, versus 12 minutes for the 2030 Existing Facility). Travel time between the Ballard Bridge and SR 519 will be about the same as in the 2030 Existing Facility scenario in the southbound direction (14 minutes versus 13 minutes for the 2030 Existing Facility) and several minutes less than in the 2030 Existing Facility (16 minutes, versus 19 minutes for the 2030 Existing Facility) in the northbound direction.

Aerial Alternative

As shown in Exhibit 5-15, for the Aerial Alternative the PM peak hour travel time for traffic traveling between the Aurora Bridge and Spokane Street will be about the same as in the 2030 Existing Facility in the southbound direction (8 minutes versus 9 minutes for the 2030 Existing Facility). In the northbound direction, travel time will be slightly less than in the 2030 Existing Facility scenario (9 minutes, versus 12 minutes for the 2030 Existing Facility). Travel time between the Ballard Bridge and SR 519 will be about the same as in the 2030 Existing Facility scenario in the southbound direction (14 minutes versus 13 minutes for the 2030 Existing Facility) and several minutes less than in the 2030 Existing Facility (15 minutes, versus 19 minutes for the 2030 Existing Facility) in the northbound direction.

Tunnel Alternative

As shown in Exhibit 5-15, for the Tunnel Alternative the PM peak hour travel time for traffic traveling between the Aurora Bridge and Spokane Street will be about the same as in the 2030 Existing Facility in the southbound direction (8 minutes, versus 9 minutes for the 2030 Existing Facility). In the northbound direction, travel time will be slightly less than in the 2030 Existing Facility scenario (9 minutes, versus 12 minutes for the 2030 Existing Facility). Travel time between the Ballard Bridge and SR 519 will be about the same as in the 2030 Existing Facility scenario in the southbound direction (14 minutes versus 13 minutes for the 2030 Existing Facility) and about the same as the 2030 Existing Facility (18 minutes, versus 19 minutes for the 2030 Existing Facility) in the northbound direction.

Bypass Tunnel Alternative

As shown in Exhibit 5-15, for the Bypass Tunnel Alternative the PM peak hour travel time for traffic traveling between the Aurora Bridge and Spokane Street will be about the same as in the 2030 Existing Facility in the southbound direction (9 minutes). In the northbound direction, travel time will be slightly higher than in the 2030 Existing Facility scenario (13 minutes, versus 12 minutes for the 2030 Existing Facility). Travel time between the Ballard Bridge and SR 519 will be much higher than in the 2030 Existing Facility scenario in the southbound direction (22 minutes versus 13 minutes for the 2030 Existing Facility), due to the revised configuration. See Section 5.3.1 for a discussion of how connections differ for this alternative. However, in the northbound direction, travel times will be about the same as in the 2030 Existing Facility (18 minutes, versus 19 minutes for the 2030 Existing Facility).

Surface Alternative

Travel times for the Surface Alternative will be much higher than in the 2030 Existing Facility due to the need to use congested surface streets. As shown in Exhibit 5-15, for the Surface Alternative the PM peak hour travel time for traffic traveling between the Aurora Bridge and Spokane Street will be 16 minutes (compared to 9 minutes for the 2030 Existing Facility). In the northbound direction, travel time will be much higher than in the 2030 Existing Facility scenario (33 minutes, versus 12 minutes for the 2030 Existing Facility). Travel between the Ballard Bridge and SR 519 will also be much higher than in the 2030 Existing Facility scenario in the southbound direction (22 minutes, versus 13 minutes for the 2030 Existing Facility), due to the need to use surface streets. See Section 5.3.1 for a discussion of how connections differ for this alternative. In the northbound direction, travel times will also be much higher than in the 2030 Existing Facility (27 minutes, versus 19 minutes for the 2030 Existing Facility).

5.5.3 Ability of Design to Facilitate Freight Operations

2030 Existing Facility

The AWV has narrow 10-foot lanes, very limited shoulders or shy distance to the edge of the roadway, limited sight distance entering and exiting the Battery Street Tunnel, lack of adequate acceleration and merging distances (particularly on the ramps at Seneca Street, Columbia Street, and the Battery Street ramps), and lack of refuge in case of breakdowns. These features reduce the AWV's ability to effectively and safely accommodate truck traffic. Additionally, trucks carrying flammable materials are restricted from using the Battery Street Tunnel, while transport of hazardous materials is prohibited on the Viaduct structure during peak hours. Weight restrictions limit truck use to the outside lanes of the AWV.

Rebuild Alternative

Wider lanes (12 feet) more suitable for use by large trucks will be provided on the AWV under the Rebuild Alternative. Widened shoulders would also be provided, except in and approaching the Battery Street Tunnel. Lane widths and shoulders will remain the same as existing conditions north of the BST. The Seneca and Columbia ramps will be constructed similar to existing conditions and will present similar problems with turning radii and lack of acceleration and deceleration lanes. Restrictions of flammable materials in the Battery Street Tunnel would remain in place, while hazardous materials could continue to be prohibited on the Viaduct structure during peak hours. Weight restrictions currently in place would be eliminated.

Aerial Alternative

The Aerial Alternative will generally improve or maintain the geometric conditions of the facility similarly to the Rebuild Alternative. In addition, the Seneca and Columbia ramps will be replaced with ramps with wider turn radii, and acceleration and deceleration lanes will be provided, improving conditions for trucks using those ramps.

Tunnel Alternative

As with other build alternatives, wide lanes (12 feet) and shoulders will be provided under the Tunnel Alternative. The Seneca and Columbia ramps will be eliminated, thus eliminating difficult turning movements at those ramps. Their function will be replaced by the King Street ramps, which will present improved geometric conditions for use by trucks. Restrictions of flammable materials in the Battery Street Tunnel would remain in place, while flammable and hazardous materials could be prohibited on throughout the rest of the tunneled portions as well. Weight restrictions currently in place would be eliminated.

Bypass Tunnel Alternative

Wide lanes (12 feet) and shoulders will be provided under the Bypass Tunnel Alternative. The Seneca and Columbia ramps will be eliminated, thus eliminating difficult turning movements at those ramps. Their function will be replaced by the King Street ramps, which will present improved geometric conditions for use by trucks. Restrictions of flammable materials in the Battery Street Tunnel would remain in place, while flammable and hazardous materials could be prohibited on throughout the rest of the tunneled portions as well. Weight restrictions currently in place would be eliminated.

Increased use of Alaskan Way by trucks accessing the BINMIC area is expected to occur under the Bypass Tunnel alternative. This street would be upgraded to provide two to three 10 to 11 foot lanes in each direction. However, trucks using this route would be subject to an increased number of signalized intersections compared to the existing BINMIC routing. In addition, this routing would introduce increased truck traffic to a high use pedestrian and bicycle area.

Surface Alternative

The Surface Alternative would provide wide lanes (12 feet) and shoulders similar to other alternatives near the SR 519 interchange, and would transition to a surface arterial near King Street. Between King Street and Pike Street, an expanded surface Alaskan Way would accommodate SR 99 traffic. Therefore, all truck traffic using the SR 99 corridor through the downtown area would travel on Alaskan Way. This street would be upgraded to provide two to four 10 to 11 foot lanes in each direction. However, trucks using this route would be subject to an increased number of signalized intersections compared to the existing BINMIC routing. In addition, this routing would introduce increased truck traffic to a high use pedestrian and bicycle area.

5.5.4 Freight Train Operations

2030 Existing Facility

In the 2030 Existing Facility scenario, the tail track from the BNSF SIG rail yard crosses E. Marginal Way near S. Atlantic Street at-grade. This switching track will also cross the access roads to the Port of Seattle's Terminal 46 at-grade. Switching operations at the SIG Rail Yard would periodically block traffic these streets.

In the north waterfront area, the BNSF mainline parallels Alaskan Way and is crossed by side streets accessing Alaskan Way.

Rebuild Alternative

In the Rebuild Alternative, the new interchange at SR 519 will provide grade-separated access over the BNSF tail track. This connection will also allow access from the waterfront to SR 519, as well as into the Terminal 46 property without at-grade railroad crossings.

The north waterfront area adjacent to the BNSF mainline will not be affected by the Rebuild Alternative.

Aerial Alternative

In the Aerial Alternative, the tail track from the BNSF SIG rail yard crosses E. Marginal Way near S. Atlantic Street at-grade. This switching track will also cross the access roads to the Port of Seattle's Terminal 46 at-grade. Switching operations at the SIG Rail Yard would periodically block traffic these streets.

In the north waterfront area, the BNSF mainline parallels Alaskan Way, and is crossed by side streets accessing Alaskan Way.

Tunnel Alternative

In the Tunnel Alternative, the new interchange at SR 519 will provide grade-separated access over the BNSF tail track. This connection will also allow access from the waterfront to SR 519, as well as into the Terminal 46 property without at-grade railroad crossings.

Traffic on Alaskan Way and on the connecting cross streets will increase under the Tunnel Alternative. As a result, the volume of traffic crossing and affected by the BNSF mainline operations will be higher than under other alternatives. Note that a design option to provide ramp access to SR 99 at Elliott Avenue and Western Avenue, rather than Alaskan Way as proposed, could be implemented and would eliminate the increased vehicle crossings of the BNSF mainline that are predicted.

Bypass Tunnel Alternative

For the Bypass Tunnel Alternative, the new interchange at SR 519 will provide grade-separated access over the BNSF tail track. This connection will also allow access from the waterfront to SR 519, as well as into the Terminal 46 property without at-grade railroad crossings.

Traffic on Alaskan Way and on the connecting cross streets will increase under the Bypass Tunnel Alternative, though to a lesser degree than under the Tunnel Alternative. Note that a design option to provide a grade-separated arterial connection from Alaskan Way to Elliott Avenue and Western Avenue could be implemented and would reduce the number of vehicle crossings of the BNSF mainline that are predicted.

Surface Alternative

For the Surface Alternative, the new interchange at SR 519 will provide grade-separated access over the BNSF tail track. This connection will also allow access from the waterfront to SR 519, as well as into the Terminal 46 property without at-grade railroad crossings.

Vehicle crossings of the BNSF mainline in the north waterfront area adjacent to the BNSF mainline are not forecasted to increase under the Surface Alternative, since connections from Alaskan Way are maintained to the Elliott/Western couplet.

5.6 Ferries

MOE FY1: Access to/from Colman Dock

Key Findings

- Access to remote holding on the west side of Alaskan Way with separated access to Colman Dock Ferry Terminal will improve traffic operations on Alaskan Way in the central waterfront and provide better vehicle access to Colman Dock. This configuration will be provided under all alternatives except the Aerial Alternative, though it could also be provided in that case as a design option. Similarly, a design option that locates holding on the east side of the corridor could instead be implemented under the Rebuild, Tunnel, and Bypass Tunnel Alternatives.

- Vehicle egress to downtown from Colman Dock will continue to result in congestion under all alternatives. However, the Rebuild, Tunnel, and Bypass Tunnel Alternatives will provide some improvement in egress capacity and intersection delay over the 2030 Existing Facility scenario.
- Traffic operations reported represent a peak-demand scenario that presumes very heavy ferry related traffic. During periods of lower demand, improved local intersection operations could be expected across all alternatives.
- Egress from Colman Dock under the Surface Alternative will result in increased congestion and degraded traffic operations on Columbia Street in downtown, since contra-flow traffic will be introduced to that street.
- Pedestrian connections and opportunities for taxi or transit drop-off are similar across alternatives, though the added congestion expected under the Surface Alternative may have some impact on either.

5.6.1 Colman Dock Ferry Terminal Access and Egress

Access to Ferry Service at Colman Dock

Vehicle traffic accesses the Colman Dock Ferry Terminal from Alaskan Way at Yesler Way. During peak hours, access is only provided from northbound Alaskan Way, via a signalized left turn. Vehicle traffic from downtown or other areas north or east of Colman Dock must circle around and access northbound SR 99, typically using routes such as First Avenue S., SR 519, or the SR 99 First Avenue S. ramps to do so.

Under the 2030 Existing Facility scenario, access to Colman Dock will be provided in the same way as today. A maximum arrival rate of 1,000 vehicles was selected for analysis of PM peak hour conditions. This rate exceeds the projected hourly vessel capacity, but does reflect that vehicle arrival rates can exceed the service rates provided, resulting in queuing both on Colman Dock and, if on-dock capacity is exceeded, at a remote holding location. An arrival rate of 1,000 vehicles reflects what is thought to be a high-end estimate of maximum vehicle arrival rates during the peak hour. During off-peak hours or if lower than presumed peak demand were realized, traffic operations at the locations reviewed in this section will be improved over what is reported.

As shown in Section 5.3.8, Exhibit 5-32, under the 2030 Existing Facility scenario, the Alaskan Way intersection with Yesler Way is forecasted to operate at LOS F under such a heavy arrival rate. The operational issues are compounded by the fact that all traffic must enter Colman Dock at a single location, from a single direction, and be a left turn across opposing traffic.

The Aerial Alternative was also evaluated with arriving vehicles accessing Colman Dock in a similar manner as today, via a northbound left turn at Yesler Way. As with the 2030 Existing Facility scenario, LOS F conditions are forecasted.

The Rebuild, Tunnel, Bypass Tunnel, and Surface Alternatives were evaluated with a different access scheme. Under these alternatives, entering traffic will arrive on a separate access road parallel to, and west of, Alaskan Way. The parallel access road will allow access to be provided remotely from the more congested central waterfront and also will allow potential location of remote holding on the west side of SR 99 (negating the need for ferry traffic to enter or cross SR 99 as it travels between the holding area and Colman Dock).

Access to the west-side holding area and parallel access road will be provided from Alaskan Way at King Street. Unlike at Yesler Way, turns onto King Street will be provided from all directions, reducing the number of vehicles that will need to be accommodated by a left turn, and also somewhat lessening the need for out of direction travel for ferry trips from downtown or points north and east.

Under the Rebuild Alternative, Alaskan Way will primarily accommodate local trips and ferry traffic. The intersection of Alaskan Way and King Street is forecasted to operate at LOS E (Exhibit 5-32), but with an approximate reduction in delay of 50 percent compared to the 2030 Existing Facility or Aerial Alternatives, which will maintain access at Yesler Way.

Under the Tunnel and Bypass Tunnel Alternatives, traffic from the King Street ramps will be added to the Alaskan Way travel stream. To maintain reasonable traffic operations at King Street, a dual northbound left turn lane is proposed. Under this configuration, the intersection of Alaskan Way and King Street will operate at LOS E under the Tunnel Alternative, and LOS F under the Bypass Tunnel Alternative under the PM peak conditions analyzed. Still, delay at the intersection will be reduced on the order of 50 percent (Tunnel Alternative) and 30 percent (Bypass Tunnel Alternative) compared to alternatives that maintain access at Yesler Way. In addition, should the Terminal 46 property be redeveloped as a different use, as has recently been proposed, additional access to the holding area and access road could be provided from S. Royal Brougham Way and S. Atlantic Street, which would decrease the demand for left turn access at S. King Street. Traffic operations would improve beyond those presented here should such redevelopment occur.

Under the Surface Alternative, additional access to the ferry holding area through the Terminal 46 property was presumed, because left turns off of the mainline corridor will need to be minimized to facilitate traffic movement on SR 99. Even with access from S. Royal Brougham Way and S. Atlantic Street, in addition to the S. King Street access, LOS F conditions at S. King Street are forecasted. These conditions would be primarily due to the heavy mainline volumes on Alaskan Way, which will serve as SR 99 along the central waterfront under the Surface Alternative. Most northbound ferry traffic would likely choose instead to access the holding area from S. Royal Brougham Way and S. Atlantic Street, which are forecasted to operate at good LOS (A and B).

Egress From Colman Dock

Traffic on arriving ferry vessels unloads to Colman Dock and immediately proceeds to exits on Alaskan Way. Depending on the ferry operating conditions, traffic exits at either, or both, Yesler Way or Marion Street. At Yesler Way, exiting traffic is forced to turn right (south), while traffic exiting at Marion Street can proceed left (north on Alaskan Way), straight (east on Marion Street into downtown), or right (south). The travel stream exiting Colman Dock is unique in that it consists of heavy, steady flow as vessels unload, followed by extended periods of no exiting traffic between ferry arrivals. Very little storage is available on the dock to accommodate queuing from Alaskan Way, so exiting traffic must be introduced to the arterial system at a high rate. Conversely, in the absence of exiting ferry traffic, no traffic from Colman Dock needs to be accommodated.

Because the traffic signals on Alaskan Way may be operated in very unique ways depending on whether traffic is exiting Colman Dock or not, quantification of traffic operations using LOS procedures can only be approximated. In practice, the intersections at Marion Street and Yesler Way currently operate under very congested conditions while ferry traffic unloads, and less congested conditions between unloading periods. To approximate a typical peak hour LOS, traffic signal timings that are optimized for overall traffic volumes were analyzed. To capture the effect of group arrival of exiting ferry traffic, peak hour factors were specifically calculated for existing ferry traffic. The resulting signal timings do not necessarily reflect actual timings that may be employed (i.e., different timing plans that vary depending on whether a vessel is unloading), but do represent the overall hourly average conditions that could be expected. In addition to LOS, a second measure, ICU, was assessed. This is a basic measure of the volume-to-capacity provided by a facility and is independent of signal timing assumptions. Assessing these two measures with the methodology employed, the relative ability of the different alternatives to accommodate ferry traffic can be assessed, even though actual operating conditions would vary depending on whether vehicle unloading was under way.

Under 2030 Existing Facility conditions, 600 vehicles were presumed to exit Colman Dock during the PM peak hour (an approximate 67 percent increase over today). This number represents the maximum vehicle capacity provided by two Bainbridge and one Bremerton ferry arrivals during the PM peak hour. Most of this traffic (535 vehicles) was presumed to exit at Marion Street, though on-dock unloading decisions by Washington State Ferries could achieve more even distribution of traffic to exit points. The remaining 65 vehicles were presumed to exit at Yesler Way. As shown in Exhibit 5-33, Marion Street is forecasted to operate on average during the PM peak hour at a very congested LOS F (171 seconds of delay). Intersection ICU (Exhibit 5-34) verifies that very congested conditions are expected (151 percent ICU). These compare to estimated values of LOS D and ICU of 121 percent today. The dramatic increase is primarily due to the assumption of increased ferry traffic in 2030, as well as a high percentage distribution of traffic to Marion Street based on anticipated on-dock unloading procedures.

Under the Rebuild, Tunnel, and Bypass Tunnel Alternatives, traffic could exit Colman Dock not only at Yesler Way and Marion Street, but also via the new access road west of Alaskan Way. Traffic that was presumed to exit at Yesler Way under 2030 Existing Facility conditions was presumed to use the parallel access road to exit at King Street. The majority of the traffic (that which was presumed to exit at Marion Street) was presumed to continue to exit at Marion Street and Yesler Way under these alternatives; 435 vehicles are presumed to exit at Marion Street, with another 100 vehicles exiting (left turn only) to Yesler Way. Actually on-dock operations could alter this presumed distribution of traffic. Increased use of King Street and corresponding reductions at Marion Street could modestly improve local traffic operations during ferry unloading at Marion Street, but similarly degrade operations at King Street. Regardless of the distribution of traffic from the dock, the intersections accommodating existing traffic are expected to operate under congested conditions.

As with the 2030 Existing Facility scenario, congested conditions are forecasted at Marion Street. LOS F conditions are forecasted for each alternative, though the average delay reported is in each case modestly lower than under the 2030 Existing Facility scenario. Similarly, the ICU for the Rebuild (149 percent), Tunnel (132 percent), and Bypass Tunnel (127 percent) Alternatives is improved (though still overcapacity) compared to the 2030 Existing Facility scenario (156 percent). The redistribution of traffic to multiple intersections, coupled with added capacity under the Tunnel and Bypass Tunnel Alternatives, is forecasted to more than offset the increased traffic volumes forecasted on Alaskan Way under these alternatives.

The Aerial Alternative will maintain the current egress scheme. LOS and ICU results for the Aerial Alternative are slightly improved compared to the 2030 Existing Facility scenario, as a result of minor differences in local traffic on Alaskan Way surface street.

The Surface Alternative will provide the same egress opportunities as the Rebuild, Tunnel, and Bypass Tunnel Alternatives. However, since Alaskan Way accommodates considerably higher volumes than even the Bypass Tunnel Alternative through the central waterfront, an additional grade-separated access to Columbia Street at First Avenue will be provided. This access will allow ferry trips into the downtown to bypass traffic congestion on Alaskan Way and will lessen impacts of the exiting ferry traffic on Alaskan Way operations. The analysis estimated that of the 540 vehicles exiting onto the central waterfront area, 300 would use the grade-separated access, 100 would continue to exit southbound onto Alaskan Way, and 140 would exit to Alaskan Way at Marion Street.

The Alaskan Way and Marion Street intersection will operate at LOS F under this operating scheme, but with less delay (85 seconds) and lower ICU (102 percent) than the 2030 Existing Facility or other Build Alternatives, since lower ferry traffic volume was presumed to affect the operations of this intersection. The grade-separated connection will reconnect to the arterial grid at Columbia Street and First Avenue and will continue as two eastbound lanes (counter to the exiting direction) to Second Avenue. Columbia Street will operate as a two-way street for the block between First Avenue and Second Avenue. The introduction of contra-flow traffic to Columbia Street, combined with the higher arterial volumes forecasted downtown, is forecasted to degrade traffic operations considerably. Extremely congested and overcapacity conditions are forecasted for the intersections of Columbia Street and First Avenue (LOS F, 192 percent ICU) and Second Avenue (LOS F, 107 percent ICU). The delay forecasted at these intersections will exceed those under the 2030 Existing Facility or other Build Alternatives by more than 40 percent at First Avenue, while nearly tripling the delay at Second Avenue. Ferry traffic using these exits will experience substantial delay, and queuing extending to Colman Dock could be expected.

Access Between Colman Dock and Remote Holding Area

The 2030 Existing Facility and Aerial Alternatives will locate remote holding on the east side of Alaskan Way and require use of Alaskan Way to access

Colman Dock. In each case, traffic exiting the holding area will mix with general-purpose traffic on Alaskan Way. In each case, only light to moderate congestion is expected along Alaskan Way between the holding area and Colman Dock, though access to Colman Dock at Yesler Way will be congested (LOS F).

The Rebuild, Tunnel, Bypass Tunnel, and Surface Alternatives will segregate traffic away from Alaskan Way, as the holding area will be located to the west. Access will be provided at King Street (as described in the previous section), which could be provided with less overall delay in each case. Once at the holding area, ferry traffic will be kept separate from arterial traffic, which could simplify ferry operating procedures, as well as lessen impacts of ferry traffic on Alaskan Way operations.

Design Option

The location of the ferry holding area could also be located on the west side under the Aerial Alternative. In this case, operating conditions and impacts similar to those identified for the Rebuild Alternative will be expected.

Similarly, as a design option, ferry holding could be located on the east side of Alaskan Way under the Rebuild, Tunnel, or Bypass Tunnel Alternatives, with impacts at Yesler Way as identified under the Aerial Alternative. This variation for the Bypass Tunnel Alternative will likely require a dual left turn entrance to Colman Dock at Yesler Way to limit traffic impacts. Ferry holding on the west side is a necessity under the Surface Alternative, because of the high traffic volumes and congestion forecasted for the corridor.

5.6.2 Pedestrian Access

Pedestrian access from downtown will be maintained or improved under each of the Build Alternatives compared to the 2030 Existing Facility scenario. Under each of the Build Alternatives, an existing overpass connection at Marion Street will be maintained or replaced, and an additional pedestrian overpass may also be constructed north of the Marion Street crossing.

Currently, vehicle-pedestrian conflicts are common on Marion Street at First and Second Avenues, as large numbers of pedestrians and vehicles exit Colman Dock simultaneously. The ferry access/egress configurations paired with the Rebuild, Tunnel, Bypass Tunnel, and Surface Alternatives will provide a modest improvement compared to 2030 Existing Facility conditions in this regard as well, since the multiple exits provided under these configurations will reduce ferry vehicle traffic that exits to Marion Street. Vehicle-pedestrian conflicts at intersections will increase somewhat due to higher vehicle traffic overall on downtown arterials under the Surface Alternative, however.

Access across Alaskan Way will also be provided under all alternatives at signalized intersections with Marion Street, Columbia Street, and Yesler Way. These are discussed in further detail in Section 5.7.

5.6.3 Drop-off, Transit, and Taxicab Access

For each alternative, provision for taxi or transit drop-off will be made on the west side of Alaskan Way. Access between Colman Dock Ferry Terminal and the drop-off zones will be similar across alternatives. Vehicle access to the drop-off zones is anticipated to be slower and impeded to a greater extent under the Surface Alternative compared to other alternatives, since congested traffic conditions are forecasted along Alaskan Way.

5.7 Pedestrians and Bicycles

MOE N1: Nonmotorized Opportunities and Impacts

Key Findings

- An additional grade separated pedestrian route across SR 99 will be provided on the Thomas Street overpass in the North Sub-area under the Aerial, Tunnel, Bypass Tunnel, and Surface Alternatives.
- All alternatives other than the 2030 Existing Facility and Rebuild Alternatives would include a widened promenade along the west side of Alaskan Way, improving pedestrian accommodation along the waterfront. The Tunnel Alternative provides the greatest opportunities for creating this promenade and other nonmotorized facilities on the waterfront.
- All alternatives will either preserve or replace existing pedestrian bridges to the waterfront. An additional pedestrian bridge could be built at or north of Madison Street.
- All alternatives include a multi-use path, bicycle lanes, or a combination of the two on the Alaskan Way corridor from Bell Street to S. Atlantic Street.
- The Bypass Tunnel and Surface Alternatives would include an increased number of lanes and considerably higher vehicle volumes on Alaskan Way, which could affect pedestrians' ability to safely and easily cross the roadway.

Variations on the potential streetscape and nonmotorized facility configurations are identified in Appendix X, Urban Design Variations. The opportunities identified in these variations are analyzed in this section.

5.7.1 Assessment of Pedestrian and Bicycle Facilities Along Alaskan Way

2030 Existing Facility

A widened sidewalk on the west side of Alaskan Way fronts waterfront businesses and attractions, acting as a pedestrian promenade. The promenade varies from 16 to 20 feet in the central waterfront area. In areas of high pedestrian use and activity such as the waterfront, a pedestrian space of 25 to 35 feet would generally be preferred to allow separation between those browsing street side activities and faster paced walkers.

The east side of Alaskan Way is only periodically fronted by sidewalks on the central waterfront, primarily at stops for the Waterfront Streetcar. Further north, sidewalk is provided between Pike Street and Clay Street. An asphalt walkway is provided for the length of Alaskan Way on the opposite (east) side of the trolley tracks. This path is used by a mix of users, including walkers and bicyclists, though it is not designed to Class 1 bikeway/multi-use path standards.

Pedestrians cross Alaskan Way both at-grade and at two pedestrian bridges. To the north, a pedestrian bridge connects to Elliott Avenue and Western Avenue at Bell Street. At Marion Street, a pedestrian bridge connects the ferry terminal to First Avenue, allowing commuters and other ferry users to access downtown without having to cross Alaskan Way at-grade. A third pedestrian bridge links the Belltown and north Pike Place Market area to Alaskan Way at Lenora Street (providing grade separation from SR 99 and the BNSF mainline), but does not cross Alaskan Way.

Surface crossings of Alaskan Way are provided regularly at intersections. The intersection at Yesler, Columbia, Marion, and Madison are signalized, allowing pedestrians to cross as Alaskan Way traffic is stopped (though pedestrians do have to contend with turning traffic from the side streets). Between Madison Street and Wall Street - a stretch of nearly one mile - signalized pedestrian crossings are provided only at University Street and Pike Street. Signalized crossing are provided at Wall and Clay Streets to the north.

Bicycle facilities are not presently provided on the corridor, though cyclists ride either in street or on the parallel asphalt path.

Rebuild Alternative

Retaining an elevated SR 99 viaduct limits the opportunities to expand nonmotorized facilities along Alaskan Way due to the space occupied by the structure. The pedestrian facilities on Alaskan Way will be similar to the existing facilities. New sections of Alaskan Way south of S. King Street would include sidewalks built to current specifications (generally 8 to10 feet wide). In the central waterfront, the waterfront promenade will be replaced to similar standards as today, while full sidewalk (10 foot minimum width) would be constructed on the east side of the roadway. Existing pedestrian facilities in the north waterfront would likewise be similar to those provided today.

Bicycle access would be provided by the addition of a Class I bikeway west of SR 99 between S. Atlantic Street and S. King Street. Between S. King Street and Pine Street, Class II on-street bicycle lanes would be added to Alaskan Way. North of Pine Street, no changes are proposed. The existing parallel asphalt trail would be retained north of Pine Street.

Existing pedestrian bridges and signalized crossings will be retained, and an additional pedestrian bridge could potentially be provided near Madison Street or further north on the central waterfront.

Aerial Alternative

Pedestrian and bicycle accommodations on Alaskan Way under the Aerial Alternative would be similar to those described for the Rebuild Alternative.

Tunnel Alternative

Pedestrian and bicycle accommodation south of S. King Street are similar under the Tunnel Alternative to the other Build Alternatives, with full sidewalks and a separated Class I bike way provided.

In the central waterfront, the Tunnel Alternative offers the most flexibility and the greatest potential for improved pedestrian and bicycle accommodation due to increased space afforded by relocating the SR 99 mainline into a tunnel facility, as well as the continued accommodation of modest levels of traffic on the surface roadway. The Tunnel Alternative will feature a widened promenade along the west side of Alaskan Way between Yesler Way and Pine Street. This promenade could be developed up to an optimal width (given the mix of uses and high demand) of 35 feet. In addition, a sidewalk will be provided for the entire length of the east side of the roadway. This sidewalk could be constructed to a wider standard than under other alternatives due to the amount of useable space within the right-of-way.

The Class I bikeway to the south could be extended to Yesler Way, where it would transition to Class II on-street bicycle lanes. As with other alternatives, these would be added to Alaskan Way between Yesler Way and Pine Street. North of Pine Street, no changes are proposed. The existing parallel asphalt trail would be retained north of Pine Street.

Existing pedestrian bridges and signalized crossings will be retained, and an additional pedestrian bridge could potentially be provided near Madison Street or further north on the central waterfront. At grade crossings on Alaskan Way would be similar to today, since the effective crossing widths for Alaskan Way would remain similar to existing conditions.

Bypass Tunnel Alternative

In the Bypass Tunnel Alternative, a widened promenade will be provided along the west side of Alaskan Way throughout the area south of Pine Street. A sidewalk will be provided on the east side of the street as far south as S. King Street.

The Class I bikeway to the south could be extended to Yesler Way, where it would transition to Class II on-street bicycle lanes. As with other alternatives, these would be added to Alaskan Way between Yesler Way and Pine Street. North of Pine Street, no changes are proposed. The existing parallel asphalt trail would be retained north of Pine Street.

Existing pedestrian bridges and signalized crossings will be retained, and an additional pedestrian bridge could potentially be provided near Madison Street or further north on the central waterfront. At grade crossings on Alaskan Way would require crossing two additional lanes of traffic, so pedestrians may not be able to cross the entire roadway during a single signal phase in some cases. Median pedestrian refuges will be provided at any location where signal timing would not allow crossing of the entire roadway during a single cycle.

Surface Alternative

In the Surface Alternative, a widened promenade will be provided along the west side of Alaskan Way throughout the area south of Pine Street. A sidewalk will be provided on the east side of the street as far south as S. King Street.

The Class I bikeway to the south could be extended to Yesler Way, where it would transition to Class II on-street bicycle lanes. As with other alternatives, these would be added to Alaskan Way between Yesler Way and Pine Street. North of Pine Street, no changes are proposed. The existing parallel asphalt trail would be retained north of Pine Street.

Existing pedestrian bridges and signalized crossings will be retained, and an additional pedestrian bridge could potentially be provided near Madison Street or further north on the central waterfront. At grade crossings on Alaskan Way would require crossing two additional lanes of traffic, so pedestrians may not be able to cross the entire roadway during a single signal phase in some cases. Median pedestrian refuges will be provided at any location where signal timing would not allow crossing of the entire roadway during a single cycle. In a few cases, some specific at-grade pedestrian crossings may need to be eliminated due to heavy turning movements from arterials connecting to Alaskan Way. For example, the westbound left turn from Madison Street onto southbound Alaskan Way is forecast to be very heavy during peak hours. Prohibition of pedestrian crossings of the south leg (across turning traffic), while allowing it across the north leg, is likely.

SR 99 Corridor Impacts to Nonmotorized Mobility

2030 Existing Facility

As described in Chapter 4, Affected Environment, the elevated segment of SR 99 south of the Battery Street Tunnel affects nonmotorized travel in a couple of ways. Between University Street and Elliott Avenue, steep grades limit east–west connections under the AWV. Additionally, the viaduct structure itself is a barrier to pedestrian travel to some degree. Its shadows, dark spaces, and noise create an unfriendly pedestrian environment.

North of the Battery Street Tunnel, SR 99 divides the grid system and separates the South Lake Union area from Lower Queen Anne and the Seattle Center area. This segment of SR 99 is at-grade, and the only pedestrian crossings provided are at Denny Way, Mercer Street, and Broad Street.

Rebuild Alternative

The same general nonmotorized impacts described for the Existing Facility would be expected under the Rebuild Alternative.

In the SR 519 area, pedestrian access will be maintained by the continuation of sidewalks on Alaskan Way and associated frontage roads of the SR 519 interchange. Additionally, sidewalks will be constructed on S. Royal Brougham Way and S. Atlantic Street between First Avenue S. near the stadiums and E. Marginal Way and Alaskan Way, crossing over the SR 99 mainline.

No new pedestrian connections are proposed in the North sub-area.

Aerial Alternative

The same general nonmotorized impacts described for the Existing Facility would be expected under the Aerial Alternative.

In the SR 519 area, pedestrian access will be maintained by the continuation of sidewalks on Alaskan Way and associated frontage roads of the SR 519 interchange. Additionally, sidewalks will be constructed on Royal Brougham and Atlantic Streets between First Avenue S. near the stadiums and E. Marginal Way and Alaskan Way, crossing under the SR 99 mainline.

In the North sub-area, the new Thomas Street overpass will provide a pedestrian connection across SR 99 midway between the existing crossings at Denny Way and Mercer Street/Broad Street.

Tunnel Alternative

In the Tunnel Alternative, access between the waterfront and downtown would be improved by removal of the Viaduct structure and relocation of mainline traffic to an underground segment. Easily identifiable, visible pedestrian routes would be provided on each of the local streets connecting downtown and Pioneer Square to the waterfront. Connections between University Street and Elliott Avenue would continue to be limited by steep grades, as with other alternatives.

Capacity on the Alaskan Way surface street would be improved in locations, and higher (but still moderate) traffic volumes expected. Pedestrian crossings would still be provided at signalized intersections and existing pedestrian bridge locations, and are not expected to be degraded compared to current conditions.

In the SR 519 area, pedestrian access will be maintained by the continuation of sidewalks on Alaskan Way and associated frontage roads of the SR 519 interchange. Additionally, sidewalks will be constructed on S. Royal Brougham Way and S. Atlantic Street between First Avenue S. near the stadiums and E. Marginal Way and Alaskan Way, crossing over the SR 99 mainline.

In the North sub-area, the new Thomas Street overpass will provide a pedestrian connection across SR 99 midway between the existing crossings at Denny Way and Mercer Street/Broad Street.

Bypass Tunnel Alternative

As under the Tunnel Alternative, the Bypass Tunnel Alternative will improve pedestrian and bicycle access between the waterfront and downtown by removing the viaduct structure and relocating a majority of traffic to an underground segment. Easily identifiable, visible pedestrian routes would be provided on each of the local streets connecting downtown and Pioneer Square to the waterfront. Connections between University Street and Elliott Avenue would continue to be limited by steep grades, as with other alternatives.

The Bypass Tunnel Alternative will increase capacity on the Alaskan Way surface street, and high traffic volumes (48,000 vehicles daily) are expected.

At-grade pedestrian crossings would be more difficult, and would involve higher potential for pedestrian-vehicle accidents. A new signalized intersection at Seneca Street would provide an added, controlled crossing. As with other alternatives, pedestrian bridges would be provided at Marion Street, Bell Street, and potentially one additional location on Alaskan Way.

The increased volumes on Alaskan Way will degrade its utility as a bike route, and likely reduce its use by recreational cyclists in particular.

In the SR 519 area, pedestrian access will be maintained by the continuation of sidewalks on Alaskan Way and associated frontage roads of the SR 519 interchange. Additionally, sidewalks will be constructed on S. Royal Brougham Way and S. Atlantic Street between First Avenue S. near the stadiums and E. Marginal Way and Alaskan Way, crossing over the SR 99 mainline.

In the North sub-area, the new Thomas Street overpass will provide a pedestrian connection across SR 99 midway between the existing crossings at Denny Way and Mercer Street/Broad Street.

Surface Alternative

The Surface Alternative will improve pedestrian and bicycle access between the waterfront and downtown by removing the elevated viaduct structure, as was described for the Tunnel and Bypass Tunnel Alternatives. However, mainline traffic will not be grade-separated from local traffic, and would instead be accommodated on surface roadways, forming a new type of barrier to pedestrian access to the waterfront. Easily identifiable, visible pedestrian routes would be provided on each of the local streets connecting downtown and Pioneer Square to the waterfront. Connections between University Street and Elliott Avenue would continue to be limited by steep grades, as with other alternatives.

The Surface Alternative will increase capacity on the Alaskan Way surface street, and very high traffic volumes (74,000 vehicles daily) and substantial congestion on the waterfront are expected. At-grade pedestrian crossings would therefore be more difficult, and would involve higher potential for pedestrian-vehicle accidents. A new signalized intersection at Seneca Street would provide an added, controlled crossing. As with other alternatives, pedestrian bridges would be provided at Marion Street, Bell Street, and potentially one additional location on Alaskan Way.

The increased volumes on Alaskan Way will degrade its utility as a bike route, and likely reduce its use by recreational cyclists in particular.

In the SR 519 area, pedestrian access will be maintained by the continuation of sidewalks on Alaskan Way and associated frontage roads of the SR 519 interchange. Additionally, sidewalks will be constructed on S. Royal Brougham Way and S. Atlantic Street between First Avenue S. near the stadiums and E. Marginal Way and Alaskan Way, crossing over the SR 99 mainline.

In the North sub-area, the new Thomas Street overpass will provide a pedestrian connection across SR 99 midway between the existing crossings at Denny Way and Mercer Street/Broad Street.

Interaction Between Nonmotorized and Vehicle Traffic

2030 Existing Facility

Pedestrians and bicycles may encounter heavy traffic and fast moving vehicles at locations where traffic enters or exits SR 99, as described for existing conditions in Chapter 4, Affected Environment. Conflicts would occur at the same ramp locations as today, but traffic during the peak hours would be higher than today (5% to 20% depending on location). Locations identified as having pedestrian-vehicle conflicts for the existing facility are side streets north of the Battery Street Tunnel, the Denny Way ramps, Battery Street ramps, Elliott Avenue/Western Avenue ramps, Seneca Street/Columbia Street ramps, and the First Avenue S. ramps

Rebuild Alternative

The Rebuild Alternative would generally experience similar issues to those identified for the existing facility regarding interaction of pedestrians and vehicles. Two areas would likely experience reduced or better managed conflict locations, however. At the northbound off-ramp to Western Avenue, the pedestrian crossing at Bell Street could be signalized to consolidate pedestrian crossings while stopping the opposing movement of vehicles exiting the highway. In the SR 519 area, signalized intersections at ramp terminals will provide an improved pedestrian environment compared to the existing First Avenue S. ramps, which do not provide any control of vehicles exiting or entering SR 99.

Aerial Alternative

The Aerial Alternative would generally experience similar issues to those identified for the Rebuild Alternative.

Tunnel Alternative

The Tunnel Alternative would change vehicle and pedestrian interaction in a number of ways. As described for the Rebuild Alternative, pedestrian accommodation at the SR 519 ramps would be improved compared to the existing First Avenue S. ramps. In addition, under the Tunnel Alternative, access to and from downtown will be located at the King Street ramps. These ramps will not have the high levels of pedestrian volumes conflicting with vehicle movements, as the current Seneca and Columbia ramps do. However, traffic volumes on the Alaskan Way surface street and Western Avenue will increase between King Street and Spring Street. These additional volumes are not expected to degrade the pedestrian environment on these local streets, however.

Ramps at Battery Street will be eliminated (as in the other alternatives), while the Elliott Avenue/Western Avenue ramps will be relocated to Alaskan Way. This later component will reduce pedestrian/vehicle conflicts on Elliott Avenue and Western Avenue, but would increase volumes on the northern segments of Alaskan Way. Pedestrian crossings on this segment of Alaskan Way would become more difficult than today, and may be prohibited at unsignalized crossings.

Bypass Tunnel Alternative

The Bypass Tunnel Alternative would experience issues similar to the Tunnel Alternative, but with much higher traffic volumes, and a higher degree of vehicle-pedestrian interactions, on Alaskan Way on the central waterfront. As described previously, increased levels of traffic would degrade the pedestrian environment on Alaskan Way. As with the Tunnel Alternative, potential pedestrian-vehicle conflicts on Elliott Avenue and Western Avenue in Belltown would be reduced.

Surface Alternative

The Surface Alternative would eliminate several ramp conflicts downtown and at the Battery Street ramps, but as with the Bypass Tunnel Alternative, would result in higher traffic volumes, and a higher degree of vehicle-pedestrian interactions, on Alaskan Way on the central waterfront. In addition, the transition from higher speed mainline sections to slower speed arterial segments introduces an added safety concern for pedestrian crossings in these transitional areas.

Volumes at the Western Avenue off-ramp would be reduced under the Surface Alternative, reducing pedestrian conflicts in that area. Traffic volumes on the Denny ramps, as well as on local streets throughout the downtown area, would increase, which would increase the potential for pedestrian conflicts area-wide to varying degrees.

5.8 Parking

MOE P1: Impact to Parking

Key Findings

- More parking spaces (short-term and long-term) will be eliminated under the Tunnel, Bypass Tunnel, and Surface Alternatives than under the Rebuild or Aerial Alternatives. The project proposes to mitigate loss of short-term parking through methods such as conversion of long-term parking to short-term, construction on new short term parking, and/or increased utilization of existing parking facilities.
- Parking impacts in the stadium area will be relatively minor, as short-term parking will not be reduced by the Build Alternatives, and current parking utilization rates show an excess of long-term parking in the area.
- The primary areas affected by loss of short-term parking (primarily provided under the existing viaduct) will be Pioneer Square and the central waterfront. Conversion of existing parking to short-term parking is one measure that is being considered to offset this loss.

This section summarizes the estimated parking impacts for each of the five proposed Build Alternatives for the Alaskan Way Viaduct, organized by sub-area. The impact to parking along the waterfront area and under the viaduct varies by alternative and sub-area. Discussion will also include potential mitigation measures and strategies as they relate to parking.

5.8.1 Parking Study Sub-areas

The parking study area includes E. Marginal Way, Alaskan Way, the Alaskan Way Viaduct, associated ramps, and the frontage areas east of the viaduct structure from a southern terminus at S. Holgate Street to Broad Street in the north. The parking data collected and estimated impacts for each Build Alternative are organized according to the four following sub-areas:

1. Stadium Sub-area – S. Holgate Street to S. King Street
2. Pioneer Square Sub-area – S. King Street to Yesler Way
3. Central Waterfront Sub-area – Yesler Way to Pine Street
4. North Waterfront Sub-area – Pine Street to Broad Street
5. South Lake Union area – Vicinity of Mercer Street and Thomas Street

Exhibits 5-46 and 5-47 illustrate the boundaries of each of the five sub-areas within the parking study area.

Because potential parking impacts are small and localized in the South Lake Union area, it was evaluated only for potential parking impacts (and not inventory) based on the various Alaskan Way Viaduct alternatives.

Estimates of potential parking impacts were conducted for each of the five alternatives. The Urban Design Concept plans, submitted with the Alaskan Way Viaduct and Seawall Replacement Project conceptual plans in May of 2003, were used as a guide for on-street parking lanes and affected off-street parking areas. As conceptual designs, these plans are approximations of one possible solution for each alternative. The final parking configuration for the selected alternative may deviate from the current concept.

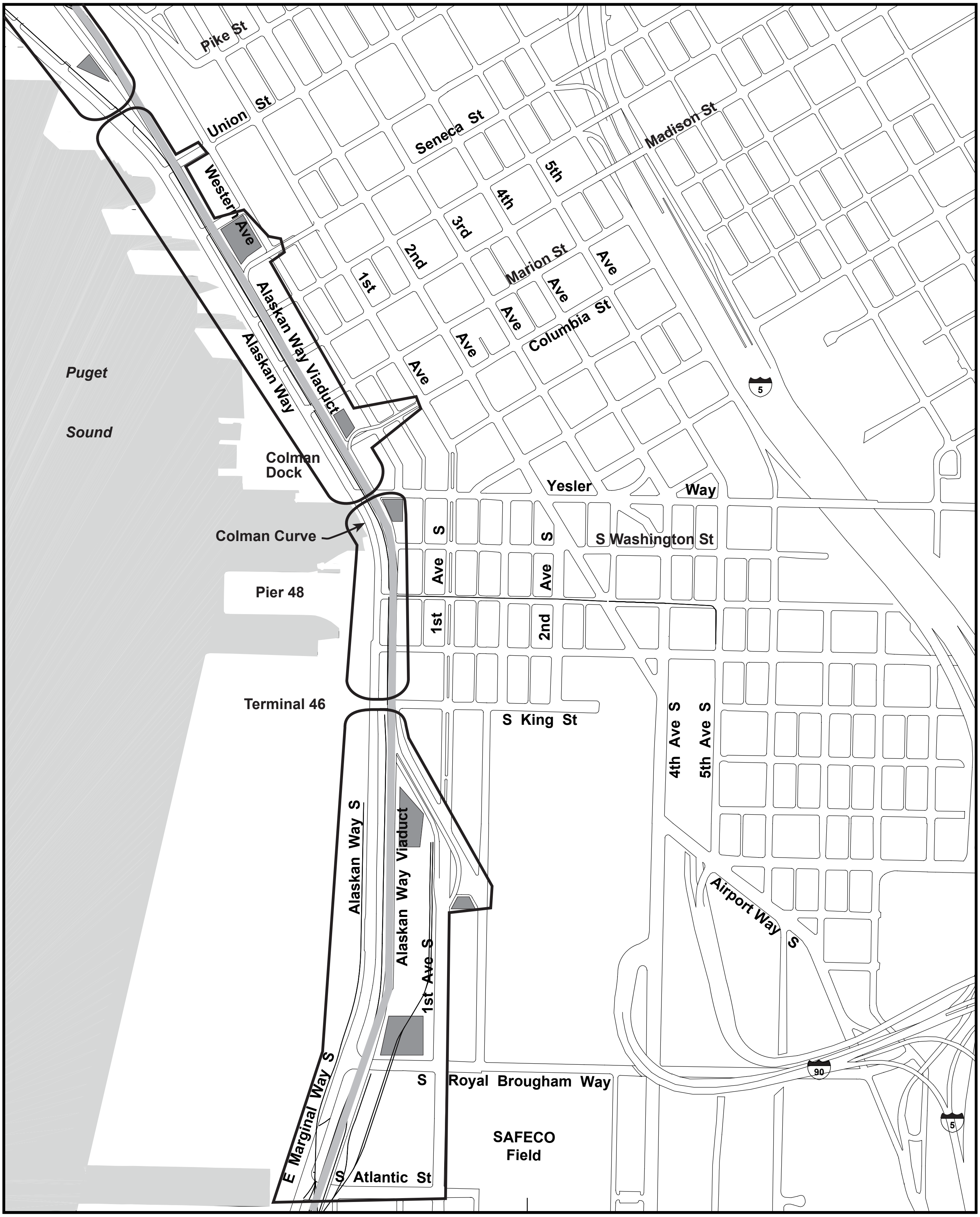
The complexion of the Seattle waterfront will evolve throughout the relatively lengthy construction activities of the selected alternative. This evolution will be influenced by local, regional, and even national socio-economic trends. Several land use variables will affect the implementation of this program. For example, future requirements for driveway and fire hydrant locations are unknown; therefore, no direct calculations were used to compensate for any resultant loss of parking spaces. This parking impact assessment provides reasonable estimates of potential parking spaces based on the five conceptual alternatives.

5.8.2 Parking Descriptions and Definitions

A variety of parking space types can be identified around the vicinity of the Alaskan Way Viaduct. The Alaskan Way Viaduct itself does not contain parking spaces; however, Alaskan Way and the area under the viaduct encompass a host of parking areas. The following provides a brief description of the parking space definitions used, along with the classification and categories used to identify parking impacts within the study area.

Parking Space Definitions

The variety of parking space types found within the parking study area ranges from metered spaces (time durations varying from 0.5, 1, and 2 hours) to parking lots requiring payment for longer durations of time. The following is a brief list of those types of spaces:



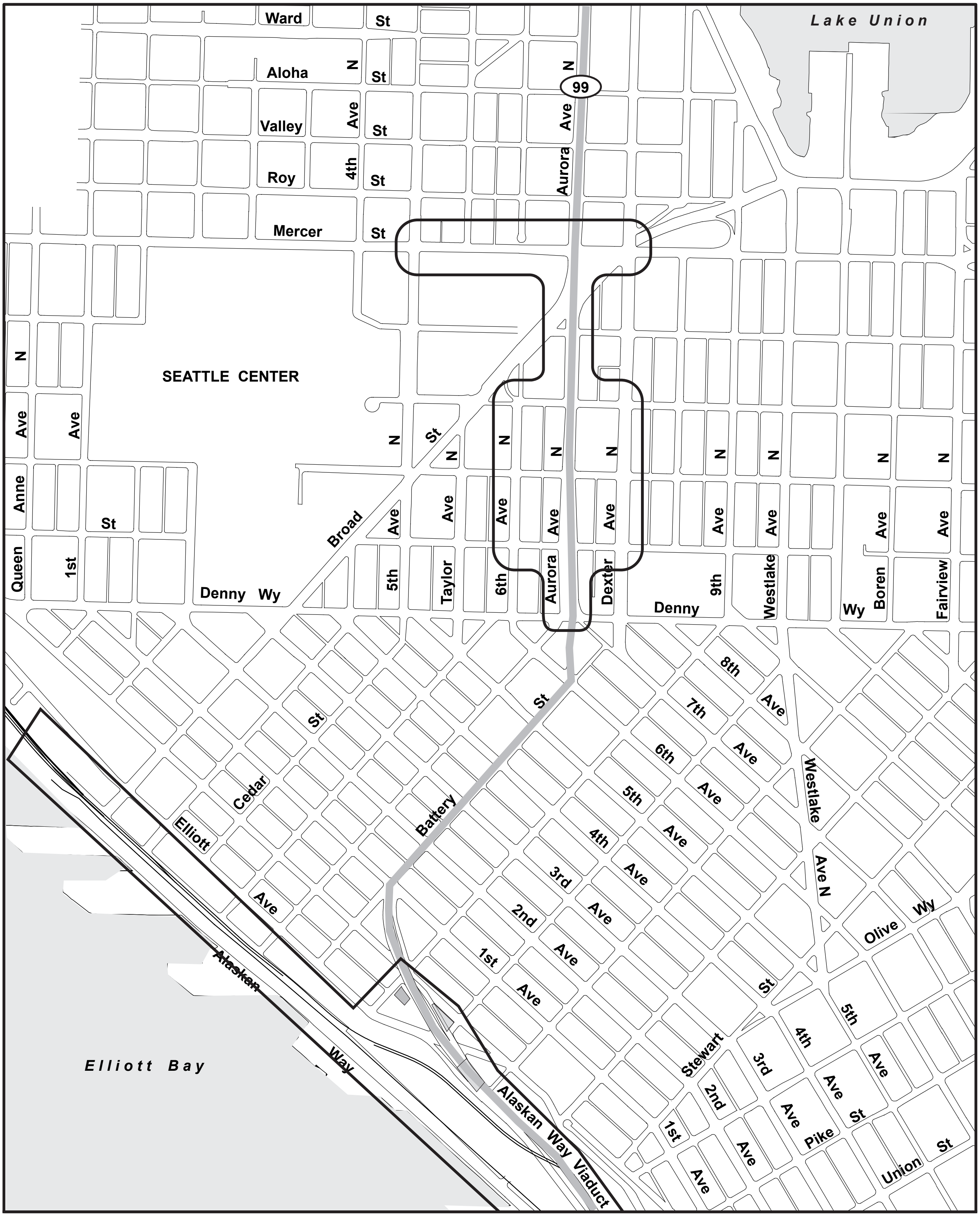
PC: Alaskan Way Viaduct 554-1585-025/06(0620) 3/04 (K)

SCALE IN FEET

0 400 800

N

Exhibit 5-46
Parking Study -
Detailed Area



PC: Alaskan Way Viaduct 554-1585-025/06(0620) 3/04 (K)

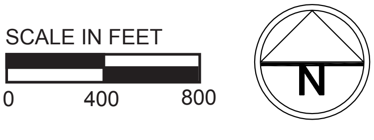


Exhibit 5-47
Parking Study - North Detailed Area

- Metered – metered parking spaces.
- Time Restrict – any public parking spaces that are time-restricted, but not metered. Includes 30 minute, 1 hour, 2 hour, and passenger and commercial loading zones.
- Bus/Taxi – parking spaces posted for buses and taxis. Includes bus stop zones.
- Non-restricted - unmetered, unrestricted, on-street public parking spaces.
- Government – parking spaces posted for police and other City government vehicles.
- Pay Parking – parking spaces that require a permit, or are let to the general public for a fee.
- Tenant Only – Off-street parking that is designated as restricted or private, and is not let to the general public for a fee.

Parking Categories

The parking space definitions are divided into the following categories:

- On-Street (short-term) Parking: Metered + Time Restrict + Bus/Taxi
- On-Street (long-term) Parking: Non-restricted + Government
- Off-Street Parking: Pay Parking + Tenant Only

Parking Data and Analysis Assumptions

Collection and analysis of parking data included the following assumptions:

- Fire lanes (red curbed areas) are not included as a part of this study.
- Holding areas for Washington State Ferries are not included in the existing or proposed parking space data.
- The SR 519 surface improvements were included as part of the baseline when determining existing parking availability and potential impacts.

5.8.3 Parking Impacts

Parking impacts are described post-construction (i.e. – conditions after the project is completed). Parking impacts during construction are discussed in Section 6.3.4.

The following sections provide a summary of estimated parking impacts to the total study area, as well as a detailed description of the parking impacts to each sub-area, for each Build Alternative. The general location of parking impacts is also discussed. As previously stated, the Urban Design Concept (UDC) plans for each alternative were the basis for estimating the number of post-construction parking spaces. Some differences among these plans, particularly in the stadium sub-area, have influenced the potential parking assessments. Among these differences are different ideas for accommodating the Washington State Ferries holding areas. Also, the Rebuild Alternative introduces a separate alignment for a mixed-use trail that will reduce potential parking beneath the viaduct structure.

Parking Impacts Summary

Exhibit 5-48 summarizes the potential parking impacts for the five Build Alternatives. The delta value under each alternative represents the estimated change from existing conditions in the same sub-area. A negative delta value indicates that the proposed alternative will reduce the number of parking spaces available as compared to existing conditions. A positive delta value indicates that an increase in the number of spaces available could occur with the implementation of that particular alternative. Overall, all five Build Alternatives are anticipated to create a reduction in parking facilities as compared to existing conditions. The reduction in the number of parking spaces ranges from over 250 spaces for the Rebuild Alternative to over 700 spaces for the Surface Alternative.

Exhibit 5-48. Summary of Parking Impacts by Build Alternative for All Sub-Areas

	On-Street			Off-Street	Other	Total
	Short-Term	Long-Term	Subtotal			
Existing	814	276	1090	900	48	2,038
Rebuild	850	20	870	850	48	1,768
Delta	**36**	**-256**	**-220**	**-50**	**0**	**-270**
Aerial	730	50	780	850	48	1,678
Delta	**-84**	**-226**	**-310**	**-50**	**0**	**-360**
Tunnel	490	0	490	830	48	1,368
Delta	**-324**	**-276**	**-600**	**-70**	**0**	**-670**
Bypass	420	20	440	840	48	1,328
Delta	**-394**	**-256**	**-650**	**-60**	**0**	**-710**
Surface	450	40	490	780	48	1,318
Delta	**-364**	**-236**	**-600**	**-120**	**0**	**-720**

Stadium Sub-Area

The stadium sub-area encompasses the area along Alaskan Way (and surrounding area) from approximately S. Holgate Street to S. King Street. Exhibit 5-49 summarizes the estimated parking impacts by alternative for the stadium sub-area.

According to the UDC plans, the Rebuild Alternative will have the greatest impact on parking in the stadium sub-area compared to the other alternatives, with a reduction of over 300 spaces. This result is a direct consequence of two factors:

1. The above-mentioned mixed-use trail.
2. The Rebuild Alternative, unlike the other alternatives, does not include many new streets with parking lanes.

Exhibit 5-49. Estimated Parking Impacts by Alternative for the Stadium Sub-Area

	On-Street			Off-Street	Other	Total
	Short-Term	Long-Term	Subtotal			
Existing	93	261	354	477	0	831
Rebuild	80	20	100	420	0	520
Delta	**-13**	**-241**	**-254**	**-57**	**0**	**-311**
Aerial	240	50	290	420	0	710
Delta	**147**	**-211**	**-64**	**-57**	**0**	**-121**
Tunnel	120	0	120	480	0	600
Delta	**27**	**-261**	**-234**	**3**	**0**	**-231**
Bypass	100	20	120	480	0	600
Delta	**7**	**-241**	**-234**	**3**	**0**	**-231**
Surface	130	40	170	420	0	590
Delta	**37**	**-221**	**-184**	**-57**	**0**	**-241**

Within the classification of short-term (on-street) parking, most alternatives remain about the same, adding 5 to 15 new spaces. However, the Surface Alternative is estimated to add more than 35 spaces and the Aerial Alternative is estimated to add more than 100 spaces. The majority of additional spaces in the Surface Alternative, according to the UDC plans, will be newly constructed on-street parking on First Avenue S. and Railroad Avenue S. in the stadium area. The Aerial Alternative also proposes additional spaces; the majority of these additional spaces, according to the UDC plans, may occur along the area west of the AWV, from S. Atlantic Street to S. Royal Brougham Way, along E. Marginal Way from approximately S. Royal Brougham Way to S. Dearborn Street, and along Alaskan Way from S. Dearborn Street to Railroad Avenue.

According to the UDC plans, most of the existing long-term (on-street) parking in this sub-area may be removed in all of the Build Alternatives. The Rebuild and Aerial Alternatives could replace the existing parking beneath the AWV structure. However, this has not been assumed in the UDC plans. The Tunnel Alternative shows that no long-term parking will be available. Within the stadium sub-area, off-street parking will not be affected to the same degree as on-street parking. The largest impact will be a reduction of just under 60 off-street parking spaces in the Rebuild, Aerial, and Surface Alternatives. The parking spaces (long-term) proposed to be eliminated are located primarily under the existing viaduct from S. Royal Brougham Way to Railroad Avenue.

Pioneer Square Sub-Area

The Pioneer Square sub-area is the smallest sub-area of the four and covers the area along Alaskan Way from approximately S. King Street (south end) to Yesler Way. Exhibit 5-50 summarizes the estimated parking impacts by alternative for the Pioneer Square sub-area.

The on-street short-term parking space impact varies widely from an estimated delta of 5 additional spaces (in the Rebuild Alternative) to a reduction of approximately 135 spaces (in both the Bypass Tunnel and Surface Alternatives). For the Bypass Tunnel and Surface Alternatives, most of the on-street short-term parking is expected to be eliminated (primarily under the viaduct or along Alaskan Way), with a few spaces remaining along Alaskan Way from S. King Street to Main Street and under the viaduct from Main Street to Washington Street.

Currently, there are approximately 15 spaces designated as long-term on-street parking in this sub-area, primarily along Alaskan Way from S. King Street to Jackson Street. The implementation of any of the five alternatives may eliminate these spaces. Off-street parking within the Pioneer Square sub-area essentially will remain unchanged. All of the proposed alternatives are expected to result in a minor increase of two spaces.

Exhibit 5-50. Estimated Parking Impacts by Alternative for the Pioneer Square Sub-Area

	On-Street			Off-Street	Other	Total
	Short-Term	Long-Term	Subtotal			
Existing	155	15	170	18	0	188
Rebuild	160	0	160	20	0	180
Delta	**5**	**-15**	**-10**	**2**	**0**	**-8**
Aerial	80	0	80	20	0	100
Delta	**-75**	**-15**	**-90**	**2**	**0**	**-88**
Tunnel	40	0	40	20	0	60
Delta	**-115**	**-15**	**-130**	**2**	**0**	**-128**
Bypass	20	0	20	20	0	40
Delta	**-135**	**-15**	**-150**	**2**	**0**	**-148**
Surface	20	0	20	20	0	40
Delta	**-135**	**-15**	**-150**	**2**	**0**	**-148**

Central Waterfront Sub-Area

The central waterfront sub-area extends along Alaskan Way from approximately Yesler Way to Pine Street, including some side streets and ramps within the vicinity of Alaskan Way. Exhibit 5-51 summarizes the estimated parking impacts by alternative for the central waterfront sub-area.

On-street short-term parking along the waterfront has a range of parking impacts depending on the alternative being studied. With the Rebuild Alternative, approximately 40 parking spaces are expected to be added in the sub-area. Both the Bypass Tunnel and Surface Alternatives will result in a reduction in on-street short-term parking of approximately 270 parking spaces, primarily underneath the existing viaduct area. There is no on-street long-term parking in this sub-area.

Exhibit 5-51. Estimated Parking Impacts by Alternative for the Central Waterfront Sub-Area

	On-Street			Off-Street	Other	Total
	Short-Term	Long-Term	Subtotal			
Existing	388	0	388	229	34	651
Rebuild	430	0	430	230	34	694
Delta	**42**	**0**	**42**	**1**	**0**	**43**
Aerial	230	0	230	230	34	494
Delta	**-158**	**0**	**-158**	**1**	**0**	**-157**
Tunnel	170	0	170	150	34	354
Delta	**-218**	**0**	**-218**	**-79**	**0**	**-297**
Bypass	120	0	120	160	34	314
Delta	**--268**	**0**	**-268**	**-69**	**0**	**-337**
Surface	120	0	120	160	34	314
Delta	**-268**	**0**	**-268**	**-69**	**0**	**-337**

For the existing off-street parking in the central waterfront sub-area, there is also a range of parking impacts, depending on which alternative is being considered. Both the Rebuild and Aerial Alternatives essentially will replace the existing number of parking spaces. The Tunnel, Bypass Tunnel, and Surface Alternatives will reduce off-street parking by approximately 70 to 80 parking spots. The reduction in spaces will occur primarily under the viaduct, as well as west of the viaduct from approximately Pike to Pine Streets.

North Waterfront Sub-Area

The north waterfront sub-area extends along the Alaskan Way arterial from approximately Pine Street to Broad Street. Exhibit 5-52 summarizes the estimated parking impacts by alternative for the north waterfront sub-area.

On-street short-term parking will remain essentially the same compared to existing conditions for most alternatives except the Tunnel Alternative. This alternative is anticipated to eliminate approximately 30 parking spaces. The reduction primarily will occur on Alaskan Way and under the viaduct from Pine to Virginia Streets.

Exhibit 5-52. Estimated Parking Impacts by Alternative for the North Waterfront Sub-Area

	On-Street			Off-Street	Other	Total
	Short-Term	Long-Term	Subtotal			
Existing	178	0	178	176	14	368
Rebuild	180	0	180	180	14	374
Delta	2	0	2	4	0	6
Aerial	180	0	180	180	14	374
Delta	**1**	**0**	**-18**	**4**	**0**	**6**
Tunnel	160	0	160	180	14	354
Delta	**--18**	**0**	**-18**	**4**	**0**	**-14**
Bypass	180	0	180	180	14	374
Delta	**2**	**0**	**2**	**4**	**0**	**6**
Surface	180	0	180	180	14	374
Delta	**2**	**0**	**2**	**4**	**0**	**6**

The off-street parking will remain essentially unchanged from existing conditions for all of the alternatives.

South Lake Union Sub Area

Most of the Alaskan Way Viaduct alternatives, except for the Rebuild Alternative, include a proposed widened Mercer Street Plan. The widened Mercer Street Plan will result in the elimination of approximately 40 on-street parking spaces along Thomas Street between Sixth Avenue N. and Dexter Avenue N. The elimination of on-street parking spaces will be needed to accommodate the proposed Thomas Street overcrossing structure.

5.8.4 Parking Mitigation

Parking mitigation strategies are described post-construction (i.e. – conditions after the project is completed). Parking mitigation approaches for impacts during construction are similar, and are discussed in Section 6.4.2.

The project does not currently propose to provide replacement parking for displaced long-term parking. Strategies to offset losses to short-term parking have been identified, however, since businesses, services, and other uses often rely on short-term parking for customer and user access. In particular, short-term parking is especially important to businesses in Pioneer Square and along the waterfront. These areas house a number of retail and service establishments, many of which do not have on-site parking due to the historic nature and density of buildings, or topographic constraints.

Depending on the alternatives, a potential loss of up to 720 total existing parking spaces (area-wide), of which up to 394 are short-term, could be realized.

The parking impact assessments of the five AWV Build Alternatives indicate that the off-street parking will be largely unaffected for the long term in the CBD, thus no mitigation strategy has been considered at this time.

Two potential mitigation strategies to offset loss of short-term parking have been identified, and are described below.

<u>New or Leased Parking</u>

A new parking structure, or conversion of existing structured parking to short-term parking, could be implemented near the waterfront or Pioneer Square. Two potential sites (Exhibit 5-53) for this replacement parking have been identified. One is located on the northwest corner of Spring Street and Western Avenue. The other site is located on the northwest corner of Yesler Way and Western Avenue.

<u>Increased Utilization of Existing Parking</u>

During normal business hours, many parking facilities are rarely fully occupied, and therefore may provide an opportunity to offset lost parking. The 2002 Parking Inventory for the Central Puget Sound Region, published by the PSRC in January 2003, found that the parking occupancy rate in the Seattle CBD is 63.2 percent.

Although the parking study area regions differ slightly from the PSRC zones as described in the 2002 Inventory Study, the PSRC zonal data does provide a close approximation to the parking utilization rate and costs associated with each region in the parking study area

The north waterfront region has an approximate utilization rate of 63.5 percent, the central waterfront region has an approximate parking utilization rate of 73.6 percent, the Pioneer Square region has an estimated 79.5 percent parking utilization rate, and the stadium region has a parking utilization rate of 46.6 percent.

Based on this data, the combined parking facilities in the stadium sub-area have sufficient capacity to mitigate the anticipated parking impacts during normal business hours. The following five commercially operated parking lots yield over 4,000 parking spaces:

1. Stadium Exhibition Center Garage
2. Union Station Parking Garage
3. "North Lot" at Second Avenue S. & S. King Street
4. Safeco Stadium Garage
5. Home Plate Parking Lot

Exhibit 5-53 illustrates the location of the five sites mentioned above (identified by their corresponding number). Assuming the estimated stadium sub-area utilization rate of 46.6 percent, over 2,100 spaces could be available on a normal business day.

In the South Lake Union area, a potential loss of approximately 40 existing on-street parking spaces was identified along Thomas Street from Sixth Avenue N. to Dexter Avenue N. Existing utilization rates in this area are modest as well, so no direct mitigation of parking loss is proposed. Additionally, most adjacent businesses in the area have their own off-street parking lots.

5.9 Accidents and Safety

MOE A1: Facility Design Features

Key Findings

- Elimination of the northbound on-ramp and southbound off-ramp at Western Avenue in all alternatives is expected to reduce accidents at those ramp locations.
- The Surface Alternative and Bypass Tunnel Alternative would are expected to significantly increase traffic on Alaskan Way surface street, potentially increasing accident rates compared to other alternatives, and increasing the potential for pedestrian/vehicle conflicts.
- The transition from a high speed highway with controlled access points to a 30-mph arterial could lead to increased accident rates for the Surface Alternative downtown.
- The Tunnel, Bypass Tunnel, and Surface Alternatives would remove the northbound off-ramp to Seneca Street and therefore should alleviate safety concerns with the inadequacy of that existing ramp. The Aerial Alternative would modestly improve the geometric features of the Seneca Street ramp.

1. Spring Street and Western Avenue
2. Yesler Way and Western Avenue
3. Stadium Exhibition Center Garage
4. Union Station Parking Garage
5. "North Lot" at Second Avenue and King Street
6. Safeco Field Garage
7. Home Plate Parking Lot

0 2,500
SCALE IN FEET

N

Exhibit 5-53
Potential Parking Mitigation Sites

- All alternatives other than the Rebuild Alternative would eliminate the off-ramps at Broad Street and Mercer Street. This is expected to result in increased low-speed right-off movements at other adjacent streets and could potentially lead to an increase in accidents related to that type of movement at those streets, as well as increased congestion and congestion-related accidents at the southbound off-ramp at Denny Way.
- The Rebuild Alternative maintains the existing left-side merge from Columbia Street. Other alternatives either improve the ramp by creating an add lane, or relocating access.
- The Bypass Tunnel would include a merge lane from SR 519 as it enters the new tunnel northbound. Heavy traffic volumes are expected on the mainline and merge at this location.
- All alternatives will include continued use of the Battery Street Tunnel, which has narrow shoulders and a narrow median.
- For all alternatives, the mainline section south of the existing First Avenue S. ramps will be realigned to provide adequate inside and outside shoulder widths. This is expected to reduce the number of accidents on this section of the mainline.

Exhibit 5-54 highlights the design features for each alternative, which are discussed in the following sections. Exhibit 5-55 describes potential changes that could affect existing HAL/PAL locations under each of the alternatives, and identifies new issues relating to safety under each of the alternatives.

5.9.1 Rebuild Alternative

Northbound SR 99

Lane widths and shoulder widths will be improved on the elevated viaduct structure compared to the existing facility. Twelve-foot wide lanes will generally be maintained south of the Battery Street Tunnel, with increased inside shoulders and full (approximately 10 feet wide) outside shoulders. Approaching the Battery Street Tunnel, lane and shoulder widths will taper in order to match the existing configuration. This area may continue to have safety issues similar to today, with a potential for fixed object-related accidents.

Exhibit 5-54. SR 99 Mainline Design Features by Alternative

		Existing Facility	Rebuild Alternative	Aerial Alternative	Tunnel Alternative	Bypass Tunnel Alternative	Surface Alternative
Mainline Design							
Access Control	SR 519	Controlled vehicle access	Controlled vehicle access	Controlled vehicle access	Controlled vehicle access	Controlled vehicle access	Controlled vehicle access
	Midtown	Controlled vehicle access	Controlled vehicle access	Controlled vehicle access	Controlled vehicle access	Controlled vehicle access	Signalized intersections
	SLU	Partially controlled (right-on, right off) access	Partially controlled (right-on, right off) access	Partially controlled (right-on, right off) access	Partially controlled (right-on, right off) access	Partially controlled (right-on, right off) access	Partially controlled (right-on, right off) access
Lane Width	SR 519	12′-13.5′	12′	12′	12′	12′	12′
	Midtown	9.5′-13′	12′	12′	12′	12′	10′-11′
	SLU	10′-13′	10′-13′	10′-13′	10′-13′	10′-13′	10′-13′
Median Type/Width (e.g. – barrier, median, multi-level)	SR 519	Multi-level	Multi-level	Multi-level	Barrier	Barrier	Median (10′-13′)
	Midtown	Multi-level	Multi-level	Multi-level	Wall	Wall	Median (15′)
	SLU	Barrier	Barrier	Barrier	Barrier	Barrier	Barrier
Inside Shoulder Width	SR 519	1′	4′	10′	4′	4′	4′
	Midtown	1′	2′-6′	10′	10′	2′	N/A
	SLU	1′	1′	1′	1′	1′	1′
Outside Shoulder Width	SR 519	1′	10′	10′	10′	10′	10′
	Midtown	1′	14′	10′	10′	8′	N/A
	SLU	1′	1′	1′	1′	1′	1′
Pedestrian Accommodation	SR 519	Pedestrians prohibited; grade separated crossings provided.	Pedestrians prohibited; grade separated crossings provided.	Pedestrians prohibited; grade separated crossings provided.	Pedestrians prohibited; grade separated crossings provided.	Pedestrians prohibited; grade separated crossings provided.	Pedestrians prohibited; grade separated crossings provided.
	Midtown	Pedestrians prohibited; grade separated crossings provided.	Pedestrians prohibited; grade separated crossings provided.	Pedestrians prohibited; grade separated crossings provided.	Pedestrians prohibited; grade separated crossings provided.	Pedestrians prohibited; grade separated crossings provided.	Pedestrians on side of roadway. Pedestrian crossings at signalized intersections.

Exhibit 5-54. SR 99 Mainline Design Features by Alternative (continued)

		Existing Facility	Rebuild Alternative	Aerial Alternative	Tunnel Alternative	Bypass Tunnel Alternative	Surface Alternative
	SLU	Pedestrians on side of roadway; no crossing of mainline allowed. Grade separated crossing at Broad Street/Mercer Street.	Pedestrians on side of roadway; no crossing of mainline allowed. Grade separated crossing at Broad Street/Mercer Street.	Pedestrians on side of roadway; no crossing of mainline allowed. Grade separated crossing at Mercer Street. Grade separated crossing at Thomas Street	Pedestrians on side of roadway; no crossing of mainline allowed. Grade separated crossing at Mercer Street. Grade separated crossing at Thomas Street	Pedestrians on side of roadway; no crossing of mainline allowed. Grade separated crossing at Mercer Street. Grade separated crossing at Thomas Street	Pedestrians on side of roadway; no crossing of mainline allowed. Grade separated crossing at Mercer Street. Grade separated crossing at Thomas Street
Ramp Design							
Maximum Grade (up or down)	SR 519	6%	8%	8%	7%	7%	8%
	Midtown	8%	8%	5%	7%	N/A	6%
	SLU	3%	3%	3%	3%	3%	3%
Outside Shoulder Width	SR 519	6′	8′	8′	8′	8′	8′
	Midtown	1′	2′	8′	8′	N/A	N/A
	SLU	N/A	N/A	N/A	N/A	N/A	N/A
Location of Merged On-Ramps (left or right side)	SR 519		E. Marginal SB On	Royal Brougham SB On	E. Marginal SB On, Royal Brougham NB On	E. Marginal SB On, Royal Brougham NB On	E. Marginal SB On, Elliott SB On
	Midtown	Columbia SB On, Western NB On	Western NB On				
	SLU						
Ramp Design Limitations (short deceleration length, limited vehicle storage at termini, or high curvature)	SR 519		Royal Brougham NB On	Royal Brougham SB On			Atlantic NB Off
	Midtown	Seneca NB Off, Columbia SB On, Western NB Off, Western NB On, Western SB Off	Seneca NB Off, Columbia SB On				
	SLU						

Exhibit 5-55. Potential to Improve or Degrade Safety

	Rebuild Alternative	Aerial Alternative	Tunnel Alternative	Bypass Tunnel Alternative	Surface Alternative
Existing HAL/PAL Locations - Northbound Mainline					
South of First Avenue Ramp	Potentially improved due to increased shoulder and lane widths.	Potentially improved due to increased shoulder and lane widths.	Potentially improved due to increased shoulder and lane widths.	Potentially improved due to increased shoulder and lane widths. Addition of merge lane northbound could negatively affect safety.	Potentially improved due to increased shoulder and lane widths. Transition of mainline to a congested surface arterial could negatively affect safety.
Western Avenue to south end of the BST	Potentially improved due to removal of NB on-ramp, though sharp curve entering BST would remain.	Potentially improved due to removal of NB on-ramp, though sharp curve entering BST would remain.	Potentially improved due to removal of NB on-ramp, though sharp curve entering BST would remain.	Potentially improved due to removal of NB on-ramp, though sharp curve entering BST would remain.	Potentially improved due to removal of NB on-ramp, though sharp curve entering BST would remain.
Existing HAL/PAL Locations - Northbound Ramps					
Off-ramp to Western Avenue	Potential for improvement due to reduced queuing as a result of channelization and signal improvements to Western Avenue, as well as removal of the SB off-ramp to Western (which eliminates a crossing flow). Signalized pedestrian crossing on Western Avenue could lower incidence of pedestrian conflicts compared to the existing marked (but unsignalized) crosswalk.	Potential for improvement due to reduced queuing as a result of channelization and signal improvements to Western Avenue, as well as removal of the SB off-ramp to Western (which eliminates a crossing flow). Signalized pedestrian crossing on Western Avenue could lower incidence of pedestrian conflicts compared to the existing marked (but unsignalized) crosswalk.	Potential for improvement due to relocation of ramp to Alaskan Way and improved ramp geometry. Traffic queuing on Alaskan Way could back into tunneled off-ramp and negatively affect safety. Increased traffic on Alaskan Way surface street north of Pike Street as a result of ramp relocation could lead to higher accident rates on that facility and would increase potential pedestrian/vehicle conflicts.	Ramp eliminated, improving expected safety of mainline operations. Increased traffic on Alaskan Way surface street as a result of ramp elimination could lead to higher accident rates on that facility and would increase potential pedestrian/vehicle conflicts.	Potential for improvement due to reduced queuing as a result of channelization and signal improvements, as well as removal of the SB off-ramp to Western (which eliminates a crossing flow). Signalized pedestrian crossing on Western Avenue could lower incidence of pedestrian conflicts compared to the existing marked (but unsignalized) crosswalk.
On-Ramp from Western Avenue	Removal of northbound on-ramp expected to improve safety.	Removal of northbound on-ramp expected to improve safety.	Removal of northbound on-ramp expected to improve safety.	Removal of northbound on-ramp expected to improve safety.	Removal of northbound on-ramp expected to improve safety.

Exhibit 5-55. Potential to Improve or Degrade Safety (continued)

	Rebuild Alternative	Aerial Alternative	Tunnel Alternative	Bypass Tunnel Alternative	Surface Alternative
Existing HAL/PAL Locations - Southbound Mainline					
BST and Western Avenue Ramp	Removal of southbound off-ramp expected to improve safety, though existing sharp curve on the mainline would remain.	Removal of southbound off-ramp expected to improve safety, though existing sharp curve on the mainline would remain.	Removal of southbound off-ramp expected to improve safety, though existing sharp curve on the mainline would remain.	Removal of southbound off-ramp expected to improve safety, though existing sharp curve on the mainline would remain.	Removal of southbound off-ramp expected to improve safety, though existing sharp curve on the mainline would remain. Transition of mainline to a congested surface arterial could negatively affect safety
Harrison to Denny Way Ramp (PAL)	No change expected.	Improved grade separated crossings at Mercer Street and Thomas Street could reduce potential pedestrian conflicts.	Improved grade separated crossings at Mercer Street and Thomas Street could reduce potential pedestrian conflicts.	Improved grade separated crossings at Mercer Street and Thomas Street could reduce potential pedestrian conflicts.	Improved grade separated crossings at Mercer Street and Thomas Street could reduce potential pedestrian conflicts.
Additional Potential Safety Issues					
			Fire suppression systems and emergency egress routes necessary in tunnel segments.	Fire suppression systems and emergency egress routes necessary in tunnel segments.	Substantial increase in traffic on Alaskan Way would increase potential pedestrian/vehicle conflicts. Replacement of limited access SR 99 with a high-volume surface arterial could increase accident rates.

The northbound Seneca off-ramp will be reconstructed similar to its current configuration, with some minor improvements to include adding an additional lane to the ramp. However, the shoulders on this ramp will not be widened, and the sharp degree of curvature will not be reduced, so a similar accident experience can be expected.

The northbound off-ramp at Western will include minor shoulder improvements as well as an improved connection to Western Avenue. Pedestrian crossings at the ramp terminal, which are uncontrolled today, will be accommodated at a signalized crossing. Also, the opposing southbound off-ramp will be closed, eliminating conflicting vehicle movements that have been observed to contribute to queuing onto the off-ramp.

The northbound Battery Street on-ramp will be closed, which should have a positive impact on safety in this high accident area.

The BST will continue to have narrow lanes and shoulders and it is expected that accident types and frequencies will not change substantially. The area north of the tunnel in the South Lake Union area will also remain as today and is expected to have similar safety issues as was found for existing conditions.

Southbound SR 99

The same general mainline features apply in the southbound direction. Also, as with the northbound Battery Street on-ramp, the southbound Battery Street off-ramp will be closed, potentially improving safety at the tunnel portal.

No significant change in accident frequencies or types is expected at the Columbia Street on-ramp, as it will remain a left-side merge ramp. However, the left-side First Avenue off-ramp will be relocated to SR 519, and will exit the roadway from the right side. This reconfiguration is better suited to meet driver expectation and will reduce weaving maneuvers between the Columbia Street and First Avenue ramps.

5.9.2 Aerial Alternative

Northbound SR 99

As with the Rebuild Alternative, lane widths and shoulder widths will be improved on the elevated viaduct structure for the Aerial Alternative compared to the existing facility. Twelve-foot lanes will generally be maintained south of the Battery Street Tunnel, with full inside (approximately10 feet wide) and outside shoulders. Approaching the Battery Street Tunnel, lane and shoulder widths will taper in order to match the existing configuration. This area may continue to have safety issues similar to today, with a potential for fixed object-related accidents.

The northbound Seneca off-ramp will be reconstructed to higher standards, with improved shoulders and more gradual curvature. The northbound off-ramp at Western will include minor shoulder improvements, as well as an improved connection to Western Avenue. Pedestrian crossings at the ramp terminal, which are uncontrolled today, will be accommodated at a signalized crossing. Also, the opposing southbound off-ramp will be closed, eliminating conflicting vehicle movements that have been observed to contribute to queuing onto the off-ramp. The northbound Battery Street on-ramp will be closed, which should have a positive impact on safety in this high accident area.

The BST will continue to have narrow lanes and shoulders, and it is expected that accident types and frequencies will not change substantially. The area north of the tunnel in the South Lake Union area will not change substantially in character from today, with similar lane widths and shoulders. Access will continue to be provided largely by side streets providing right-on, right-off access. Removal of the Broad Street and Mercer Street exit ramps will increase the reliance on right-turn exits to side streets, which require deceleration in-lane on the SR 99 mainline. Increased use of these exits could potentially increase accident rates over those experienced today.

While pedestrians are prohibited from crossing SR 99 north of the BST, this segment is identified as a high Pedestrian Accident Location (PAL). Pedestrian accidents can occur where pedestrians cross the side street connections, or in the event of illegal crossing of the SR 99 mainline by pedestrians. The Thomas Street overpass could potentially have a positive impact on pedestrian accident rates, as it would provide a grade-separated crossing over SR 99 approximately midway between the other pedestrian crossings at Mercer Street and Denny Way.

Southbound SR 99

The same general mainline features apply in the southbound direction. As with northbound, the southbound Battery Street off-ramp will be closed, potentially improving safety at the tunnel portal.

For the Aerial Alternative, the Columbia Street on-ramp will be reconstructed with wider shoulders and improved curvature and will join the mainline as an add lane (rather than a left side merge), eliminating conflicts with mainline traffic and potentially reducing accident rates. Additionally, the left-side First Avenue off-ramp will be relocated to SR 519 and will exit the roadway from the right side. This reconfiguration is better suited to meet driver expectation and will reduce weaving maneuvers between the Columbia Street and First Avenue ramps.

5.9.3 Tunnel Alternative

Northbound SR 99

The Tunnel Alternative would improve lane widths and shoulder widths compared to the existing facility south of the Battery Street Tunnel. Twelve-foot lanes will generally be maintained south of the Battery Street Tunnel, with improved inside and full (approximately 10 feet) outside shoulders. Approaching the Battery Street Tunnel, lane and shoulder widths will taper in order to match the existing configuration. This area may continue to have safety issues similar to today, with a potential for fixed object-related accidents.

No ramps will be provided to downtown in the new tunnel segment, with access instead being provided from the King Street ramps near the SR 519 interchange. The King Street off-ramp will be constructed to higher standards than the existing Seneca Street ramp, and is expected to operate so that ramp congestion does not affect mainline operations.

The northbound off-ramp at Western will be replaced by a ramp from the new tunnel segment to Alaskan Way. Occasional ramp congestion is expected on this ramp, which could be problematic due to limited sight distance on the ramp, which is itself a tunnel segment.

The northbound Battery Street on-ramp will be closed, which should have a positive impact on safety in this high accident area.

The new tunnel segment between King Street and Pike Street will require fire suppression systems and emergency egress facilities.

Conditions in and north of the Battery Street Tunnel would be similar to those described for the Aerial Alternative.

Southbound SR 99

The same general mainline features apply in the southbound direction. As with northbound, the southbound Battery Street off-ramp will be closed, potentially improving safety at the tunnel portal. The new on-ramp from Alaskan Way will be located further from the Battery Street Tunnel exit, possibly improving safety southbound on the mainline.

No on-ramp would be provided directly from downtown, as the Columbia Street on-ramp will be replaced by a ramp near King Street. This ramp will be located on the right side of the roadway, and constructed as an add lane, improving the expected safety compared to the existing Columbia Street ramp. Additionally, the left-side First Avenue off-ramp will be relocated to

SR 519, where it will exit the roadway from the right side. This reconfiguration is better suited to meet driver expectation.

Alaskan Way Surface Street

The Tunnel Alternative will increase traffic on the surface street Alaskan Way south of Madison Street, though expected volumes will be at levels consistent with those on other streets in the downtown area. Accident rates may increase slightly on Alaskan Way, but improved safety elsewhere caused by removal of the Seneca and Columbia ramps could offset any increase. The overall accident experience on surface streets is not expected to change notably under the Tunnel Alternative.

5.9.4 Bypass Tunnel Alternative

Northbound SR 99

The Bypass Tunnel Alternative would improve lane widths compared to the existing facility, as 12-foot wide lanes will generally be maintained south of the Battery Street Tunnel. Shoulder widths would increase only slightly, however, to two feet in the new tunnel segment. Approaching the Battery Street Tunnel, lane and shoulder widths will taper to match the existing configuration. This area may continue to have safety issues similar to today, with a potential for fixed object-related accidents.

No ramps will be provided to downtown in the new tunnel segment, with access instead being provided from the King Street ramps near the SR 519 interchange. The King Street off-ramp will be constructed to higher standards than the existing Seneca Street ramp, and even with high exiting volumes, is not expected to affect mainline operations adversely. The northbound on-ramp from SR 519 could potentially increase accident rates compared to the current ramp from First Avenue, since the ramp will carry high traffic volumes and merge into two mainline lanes, rather than joining as an add lane. However, the ramp will be constructed to higher geometric standards than the existing ramp.

No other ramps will be provided south of the Battery Street Tunnel.

The new tunnel segment between King Street and Pike Street will require fire suppression systems and emergency egress facilities.

Issues relevant to safety in and north of the Battery Street Tunnel would be similar to those described for the Aerial Alternative. Because turning volumes and mainline volumes on the segment north of the Battery Street Tunnel are higher under the Bypass Tunnel Alternative, potential exists for higher accident rates in this area under the Bypass Tunnel Alternative.

Southbound SR 99

The same general mainline features apply in the southbound direction. As with northbound, no ramps will be provided between the Battery Street Tunnel and the southbound on-ramp at King Street. The King Street ramp will join the mainline as a right-side add lane, reducing potential vehicle conflicts compared to the existing Columbia Street on-ramp.

The left-side First Avenue off-ramp will be relocated to SR 519, and will exit the roadway from the right side. This reconfiguration is better suited to meet driver expectation.

Alaskan Way Surface Street

The Bypass Tunnel Alternative will increase traffic considerably on the Alaskan Way surface street. Because accident rates are generally higher on surface streets than on limited access roadways, the Bypass Tunnel Alternative could lead to an overall increase in accidents for traffic that shifts off of the SR 99 corridor and onto Alaskan Way. Right angle and rear end accidents in particular could increase. The potential for vehicle-pedestrian accidents would also increase along the waterfront given the increase in traffic in this area of high pedestrian activity. Pedestrian accidents are especially a concern given the severity of injuries often associated with these types of accidents.

5.9.5 Surface Alternative

Northbound SR 99

The Surface Alternative would construct improvements in the SR 519 area similar to under the Rebuild, Tunnel, and Bypass Tunnel Alternatives. North of the SR 519 area, SR 99 would transition to a surface arterial, in essence becoming Alaskan Way. Congestion on the arterial is expected to be severe during the peak periods. The transition from a high speed, limited access highway to a congested, lower speed arterial could potentially result in increased accident rates, particularly rear end accidents.

The Surface Alternative will increase traffic considerably on the Alaskan Way surface street. Because accident rates are generally higher on surface streets than on limited access roadways, the Surface Alternative could lead to an overall increase in accidents. Congested conditions at signalized intersections and increased turning vehicles could increase right angle accidents. The potential for vehicle-pedestrian accidents would also increase along the waterfront given the increase in traffic in this area of high pedestrian activity. Pedestrian accidents are especially a concern given the severity of injuries often associated with these types of accidents.

Issues relevant to safety in and north of the Battery Street Tunnel would be similar to those described for the Aerial Alternative. Mainline volumes would be lower under the Surface Alternative than under existing conditions, though northbound entering and southbound existing volumes would increase. The potential for changes in accident rates is therefore mixed.

Southbound SR 99

The same general mainline features apply in the southbound direction.

The left-side First Avenue off-ramp will be relocated to SR 519, where it will exit the roadway from the right side. This reconfiguration is better suited to meet driver expectation.

Chapter 6 Construction Impacts

The following chapter describes the outcomes of the traffic analysis for the Build Alternatives during construction. The analysis is based on an evaluation of reduction of project corridor lane carrying capacity by total months. It also includes an assessment of traffic impacts anticipated in specific locations in the corridor and how those impacts would affect multi-modal transportation operations. More detailed description of the assessment methodology can be found in Chapter 2, Methodology.

6.1 Common Traffic Provisions For All Alternatives

Construction approaches for all of the alternatives are discussed in detail in Appendix B, Alternatives Description and Construction Methods Technical Memorandum. Construction estimates defined in this report will be refined once a Preferred Alternative is selected and additional information is known regarding project design requirements.

Appendix B also documented the common construction assumptions regarding traffic provisions. These common traffic provisions are listed below to provide context to the reader of this chapter.

- All estimated durations and sequencing of construction activities assume that construction could occur 24 hours a day, 7 days a week throughout the construction period. Continuous construction is proposed to minimize overall project costs and to shorten the time it takes to build the project.
- Closures of SR 99 during off-peak traffic hours, such as nights and weekends, will be permissible.
- Closures of SR 99 for up to 2-week periods will be permissible.
- SR 99 summer closures for up to 10 weeks will be permitted between Pike Street and Denny Way (including the BST) for all alternatives except for the Rebuild.
- On SR 99, two lanes of traffic in each direction will be maintained during peak traffic hours, or a detour maintaining two traffic lanes (arterial or limited access) will be provided, except when closures are allowed as described in the bullets above.
- On the Alaskan Way surface street/E. Marginal Way, one lane of traffic in each direction will be maintained during construction or a comparable detour will be provided.
- Access to SR 99 at S. Royal Brougham Way and S. Atlantic Street will be maintained during periods when downtown access is closed.

- Access to the waterfront piers and businesses will be maintained during construction.
- The Waterfront Streetcar will be removed for the duration of construction and will be replaced as part of the surface street improvement work.

Although these are the working assumptions used to estimate construction costs and construction activity durations (for each alternative), it must be noted that as the engineering design is refined, and more information is known, further lane restrictions and/or long-term lane closures may be necessary.

6.2 Alternative Summaries

Before the initiation of major construction activities, site preparation work, including relocation of parking, removal of the Waterfront Streetcar, utility relocation, and other construction-related activities, will be initiated. These activities are similar among alternatives and will take 18 months to complete. Since the construction impacts are minor relative to the other construction stages, and the durations are the same for all alternatives, this stage is not included in the assessment of construction impacts in the following sections.

6.2.1 Rebuild Alternative

Summary of Construction Sequencing Plan and Traffic Provisions

This alternative involves rebuilding the double-level and retrofitting the single-level structures of the existing viaduct in its existing location while keeping the viaduct open to traffic. The construction activities will be completed in 86 months (7.5 years). The traffic provisions for each traffic stage are described below and summarized in Exhibit 6-1.

Traffic Stage 2 – Construction of Seawall, Begin Rebuilding Double-Level Viaduct and Retrofitting Single-Level Viaduct, Construct West Half of SR 519 Interchange

During Stage 2, SR 99 traffic will remain on the viaduct, with two lanes moving in each direction. On Alaskan Way surface street, one lane of traffic will be maintained for each direction. The temporary Alaskan Way will be located under the existing viaduct (S. Massachusetts Street to Pike Street) and on the widened Alaskan Way surface street (Pike Street to Broad Street). In addition to rebuilding the seawall, the west half of the SR 519 interchange will also be initiated, while the ramps at First Avenue S. will remain open.

Traffic Locations (Traffic Stage 2):

- SR 99 northbound – on viaduct
- SR 99 southbound – on viaduct
- Alaskan Way (south of Pike Street) – under existing viaduct
- Alaskan Way (north of Pike Street) – streetcar rail bed

Exhibit 6-1. Rebuild Alternative Traffic Provisions for All Traffic Stages (Stage 2 Through Completion)

Traffic Stage	Duration (Months)	Provisions for Traffic on SR 99	SR 519 Interchange	Ramps – First Avenue S.	Ramps – Midtown	Ramps – Western/Elliott	Provisions for Traffic on Alaskan Way
2. Seawall Construction & SR 519 Interchange	24	On existing viaduct with 2 lanes open for traffic during peak hours	Construct Interchange	Open	Open	Open	1 lane in each direction
3. Rebuild Viaduct	54	On viaduct under construction with 2 lanes open for traffic during peak hours	Continue construction activities	Remove after completion of SR 519 interchange	Close for 24 months after SR 519 ramps open	Close for 24 months when SR 519 and midtown ramps can be open	1 lane in each direction
4. Restoration	8	On completed viaduct	Open	Removed	Open	Open	1 lane in each direction
Total Months	86						
Approx. Total –Years	7.5						

Traffic Stage 3 – Complete Rebuild of Double-Level Viaduct and Retrofit of Single-Level Viaduct, Construct East Half of SR 519 Interchange

The retrofitting work of the ramps in the midtown area and in the Western/Elliott Avenues corridor will require temporary ramp closure, especially during off-peak hours. The ramp construction work will be staggered so that at least two ramps in each direction will be available for servicing mainline traffic.

Alaskan Way surface street traffic (S. Massachusetts Street to Pike Street) will be routed to the west of the existing viaduct. This will allow for the double-level viaduct to be rebuilt and the single-level viaduct to be retrofitted.

Traffic Locations (Traffic Stage 3), S. Hanford Street to S. King Street:

- SR 99 northbound – at-grade
- SR 99 southbound – at-grade
- Alaskan Way (south of Pike Street) – above seawall
- Alaskan Way (south of S. King Street) – west of existing alignment
- Alaskan Way (north of Pike Street) – streetcar rail bed

Traffic Stage 4 – Surface Street Restoration and Project Closeout

The rebuilding and retrofitting of the existing viaduct will have been completed before the beginning of this traffic stage, and SR 99 traffic will make full use of the new viaduct. During the final traffic stage of construction for the Rebuild Alternative, all traffic will be routed into its final configurations and surface restoration will be completed.

6.2.2 Aerial Alternative

Summary of Construction Sequencing Plan and Traffic Provisions

This alternative involves building an entirely new aerial structure in the location of the existing viaduct. A temporary viaduct to the west of the existing viaduct structure will be provided for SR 99 traffic. The single-level temporary viaduct will have two lanes in each direction. Once SR 99 is detoured onto the temporary viaduct, the existing viaduct will be removed and the new aerial structure will be constructed. Traffic staging and traffic provisions for the Aerial Alternative are described in the text below and summarized in Exhibit 6-2. The construction work will be completed in 129 months.

Traffic Stage 2 – Construction of Seawall and Temporary Viaduct

SR 99 traffic will remain on the Alaskan Way Viaduct with two lanes moving in each direction. On Alaskan Way surface street, one lane of traffic will be maintained in each direction under the existing viaduct (S. Massachusetts Street to Pike Street) and on the widened Alaskan Way surface street (Pike Street to Broad Street). During Traffic Stage 2, the seawall will be rebuilt with the temporary viaduct. In addition, the temporary detour structures (including the separation structure at the intersection of Alaskan Way and Broad Street) and roadways will be constructed for the Broad Street Detour.

To make room for construction of the new aerial structure between Pike Street and the Battery Street Tunnel, the northbound off-ramp at Western Avenue will be removed and the existing northbound viaduct will be widened to the east to accommodate two lanes of traffic.

Traffic Locations (Traffic Stage 2):

- SR 99 northbound – on viaduct
- SR 99 southbound – on viaduct
- Alaskan Way (south of Pike Street) – under existing viaduct
- Alaskan Way (north of Pike Street) – streetcar rail bed

Exhibit 6-2. Aerial Alternative Traffic Provisions for All Traffic Stages (Stage 2 Through Completion)

Traffic Stage	Duration (Months)	Provisions for Traffic on SR 99	SR 519 Interchange	Ramps – First Avenue S.	Ramps – Midtown	Ramps – Western/Elliott	Provisions for Traffic on Alaskan Way
2. Construct Seawall & Temporary Viaduct	36	Same as existing	None	Open	Open	NB Western off-ramp to be removed for constructing viaduct (Pike Street to Battery Street Tunnel)	1 lane in each direction
3. Construct New SB Aerial (Pike to Battery Street Tunnel) & Upgrade SB Battery Street Tunnel	30	NB traffic will remain on existing viaduct; SB traffic to be diverted to Broad Street and temporary on-ramp	None	Open	Open	NB Western off-ramp removed	1 lane in each direction
4. Remove AWV, Construct Aerial Structure and Perform NB Battery Street Tunnel Upgrade	48	On temporary facilities	To be constructed	Remove after completion of SR 519	Closed	NB Western off-ramp removed; SB traffic via Alaskan Way	1 lane in each direction
5. Restoration	15	On completed viaduct	Open	Removed	Open	Open	1 lane in each direction
Total Months	129						
Approx. Total Years	11						

Traffic Stage 3 – Construction of Southbound Aerial (Pike Street to Battery Street Tunnel) and the Southbound Battery Street Tunnel Improvements

During the 30 months of Stage 3 construction, SR 99 northbound traffic will remain on the northbound viaduct using two lanes. Southbound traffic will use the Broad Street Detour and temporary viaduct. Alaskan Way surface street traffic will be diverted to a temporary roadway above the seawall and under the temporary viaduct with one lane each in each direction.

Traffic Locations (Traffic Stage 3):

- SR 99 northbound – on viaduct
- SR 99 southbound – on Broad Street Detour
- Alaskan Way (south of Pike Street) – under existing viaduct
- Alaskan Way (north of Pike Street) – streetcar rail bed

Traffic Stage 4 – Remove Viaduct, Construct Aerial Structure, and Perform Northbound Battery Street Tunnel Upgrade

During Stage 4's 48 months of construction activities, northbound SR 99 traffic will be diverted from the existing viaduct to the new southbound aerial structure (Pike Street to Battery Street Tunnel), the southbound side of the Battery Street Tunnel, and the northbound side of the temporary viaduct (S. King Street to Pike Street). Southbound SR 99 traffic will continue to use the Broad Street Detour. Alaskan Way surface street traffic will be diverted to a temporary roadway under the temporary viaduct along the waterfront.

Traffic Locations (Traffic Stage 4):

- SR 99 northbound – on southbound aerial (Pike Street to BST), southbound BST, and northbound temporary viaduct
- SR 99 southbound – on Broad Street Detour
- Alaskan Way (south of Pike Street) – under temporary viaduct/above seawall
- Alaskan Way (north of Pike Street) – streetcar rail bed

Traffic Stage 5 – Surface Restoration

During Stage 5's 15 months of construction activities, all SR 99 traffic will be diverted to the permanent configuration, while one traffic lane in each direction will be provided on Alaskan Way surface street.

6.2.3 Tunnel Alternative

Summary of Construction Sequencing Plan and Traffic Provisions

SR 519 will have an elevated interchange with SR 99 at-grade south of King Street. From S. King Street to Pike Street, the Tunnel Alternative includes a southbound tunnel and an adjacent northbound tunnel. An aerial structure connects the new tunnel (Pike Street) to the Battery Street Tunnel.

The new southbound tunnel and the southbound aerial structure (Pike Street to Battery Street Tunnel) will be completed first. Subsequently, both northbound and southbound traffic will be diverted to the new southbound tunnel for temporary accommodations and the existing viaduct can be removed. The existing Alaskan Way Viaduct will have to be removed before the northbound tunnel can be constructed. After the completion of the new northbound tunnel, traffic will be directed to the final configuration.

Construction sequencing, staging, and traffic provisions for the Tunnel Alternative are described in the text below and summarized in Exhibit 6-3. The construction work will be completed in 109 months.

Exhibit 6-3. Tunnel Alternative Traffic Provisions for All Traffic Stages (Stage 2 Through Completion)

Traffic Stage	Duration (Months)	Provisions for Traffic on SR 99	SR 519 Interchange	Ramps – First Avenue S.	Ramps – Midtown	Ramps – Western/Elliott	Provisions for Traffic on Alaskan Way
2. Construct Seawall, SB Tunnel, & Broad Street. Detour	24	Same as existing	Construct interchange & SB ramps	Open	Open	NB Western off-Ramp to be removed for constructing viaduct (Pike to Battery Street Tunnel)	1 lane in each direction
3. Construct New SB Aerial (Pike Street to Battery Street Tunnel) & Upgrade SB Battery Street Tunnel	36	NB traffic will remain on existing viaduct; SB traffic to be diverted to Broad Street and temporary Alaskan Way on-ramp	Construct interchange & SB ramps	Open	Open	NB Western off-ramp removed, SB traffic diverted to temporary Alaskan Way on-ramp	1 lane in each direction
4. Remove AWV, Construct NB Tunnel, & Perform NB Battery Street Tunnel upgrade	36	Both NB and SB traffic in new SB tunnel	SB ramps completed; NB ramps under construction	Removed	Removed	NB Western off-ramp removed; SB traffic via new Alaskan Way SB on-ramp	1 lane in each direction
5. Restoration	13	In completed new tunnels	Open	Removed	None	Via new Alaskan Way ramps	1 lane in each direction
Total Months	109						
Approx. Total Years	9						

Traffic Stage 2 – Construction of Seawall and Start Southbound Tunnel

During Stage 2, SR 99 traffic will remain on the Alaskan Way Viaduct (two lanes each way), while Alaskan Way surface street traffic will be restricted to one lane each direction operating under the existing viaduct from S. Main Street to Pike Street, and then on the widened Alaskan Way surface street from Pike Street to Broad Street.

Traffic Locations (Traffic Stage 2):

- SR 99 northbound – on viaduct
- SR 99 southbound – on viaduct
- Alaskan Way (south of Pike Street) – under existing viaduct
- Alaskan Way (north of Pike Street) – streetcar rail bed

Traffic Stage 3 – Complete Southbound Tunnel and Construct Southbound Aerial (Pike Street to Battery Street Tunnel), and West Half of SR 519 Interchange

During the 36 months of Stage 3 construction, SR 99 northbound traffic will remain on the existing viaduct with two lanes. Southbound traffic will use the Broad Street Detour. Alaskan Way surface street traffic will be diverted under the existing Alaskan Way Viaduct with one lane each way.

Traffic Locations (Traffic Stage 3):

- SR 99 northbound – on viaduct
- SR 99 southbound – on Broad Street Detour
- Alaskan Way (south of Pike Street) – under existing viaduct
- Alaskan Way (north of Pike Street) – streetcar rail bed

Traffic Stage 4 – Remove AWV, Construct Northbound Tunnel, Construct Northbound Aerial Structure (Pike Street to Battery Street Tunnel) and East Half of SR 519 Interchange

During Stage 4's 36 months of Tunnel Alternative construction activities, northbound SR 99 traffic will be diverted to the southbound Battery Street Tunnel, the new southbound aerial structure (Pike Street to Battery Street Tunnel), and into the completed southbound tunnel. Southbound SR 99 traffic will be maintained on the Broad Street Detour. The Alaskan Way surface street traffic will be diverted to the temporary roadway above the new southbound tunnel.

Traffic Locations (Traffic Stage 4):

- SR 99 northbound – on southbound aerial (Pike Street to BST), southbound BST, and northbound temporary viaduct
- SR 99 southbound – on Broad Street Detour into new southbound tunnel
- Alaskan Way (south of Pike Street) –above new southbound tunnel
- Alaskan Way (north of Pike Street) – streetcar rail bed

Traffic Stage 5 – Surface Restoration and Project Closeout

During Traffic Stage 5's 13 months of construction activities, all SR 99 and Alaskan Way surface street traffic will be diverted to their permanent configurations.

6.2.4 Bypass Tunnel Alternative

Summary of Construction Sequencing Plan and Traffic Provision

The new bypass tunnel between S. King Street and Pike Street generally runs parallel and to the west of the existing Alaskan Way Viaduct structure. The new bypass tunnel will be completed for accommodating both northbound and southbound traffic before the demolition of the viaduct structure. The bypass tunnel has the same overall tunnel width as just the southbound tunnel in the Tunnel Alternative. Under the Bypass Tunnel Alternative, a separate tunnel will not be constructed for northbound SR 99 traffic.

Construction sequencing, staging, and detour routes for the Bypass Tunnel Alternative are described in the text below and summarized in Exhibit 6-4. The construction will be completed in 102 months.

Exhibit 6-4. Bypass Tunnel Alternative Traffic Provisions For All traffic Stages (Stage 2 Through Completion)

Traffic Stage	Duration (Months)	Provisions for Traffic on SR 99	SR 519 Interchange	Ramps – First Avenue S.	Ramps – Midtown	Ramps – Western/Elliott	Provisions for Traffic on Alaskan Way
2. Construct Seawall, SB Tunnel, & Broad Street Detour	24	Same as existing	Construct interchange	Open	Open	NB Western off-ramp to be removed for constructing viaduct (Pike Street to Battery Street Tunnel)	1 lane in each direction
3. Construct New SB Aerial (Pike Street to Battery Street Tunnel) & Upgrade SB Battery Street Tunnel	30	NB traffic remain on existing viaduct; SB traffic diverted to Broad Street & temp. Alaskan on-ramp	Construct interchange & SB ramps	Open	Open	NB Western off-ramp removed, SB traffic diverted to temporary Alaskan Way on-ramp	1 lane in each direction
4. Remove AWV, Construct NB Tunnel, & Perform NB Battery Street Tunnel upgrade	30	Both NB and SB traffic in new SB tunnel	SB ramps completed; NB ramps under construction	Removed	Removed	NB Western off-ramp removed; SB traffic via temporary Alaskan Way SB on-ramp	1 lane in each direction
5. Restoration	18	In new bypass tunnels	Open	Removed	None	None	1 lane in each direction
Total Months	102						
Approx. Total Years	8.5						

Traffic Stage 2 – Construction of Seawall and Start New Bypass Tunnel

During Stage 2, SR 99 traffic will remain on the Alaskan Way Viaduct (two lanes each way), while Alaskan Way surface street traffic will be restricted to one lane in each direction operating under the existing viaduct from S. Main Street to Pike Street and on the widened Alaskan Way surface street from Pike Street to Broad Street.

Traffic Locations (Traffic Stage 2):

- SR 99 northbound – on viaduct
- SR 99 southbound – on viaduct
- Alaskan Way (south of Pike Street) – under existing viaduct
- Alaskan Way (north of Pike Street) – streetcar rail bed

Traffic Stage 3 – Complete Bypass Tunnel, Southbound Aerial Construction (Pike Street to Battery Street Tunnel), Southbound Battery Street Tunnel Upgrade, and West Half of SR 519 Interchange

During Stage 3, SR 99 will have two lanes provided in each direction. Northbound traffic will travel on the existing viaduct, and southbound traffic will be routed to the Broad Street Detour. Alaskan Way surface street traffic will continue to have one lane provided in each direction and will be routed under the existing viaduct.

Traffic Locations (Traffic Stage 3):

- SR 99 northbound – on viaduct
- SR 99 southbound – on Broad Street Detour
- Alaskan Way (south of Pike Street) – under existing viaduct
- Alaskan Way (north of Pike Street) –streetcar rail bed

Traffic Stage 4 – Remove Viaduct, Construct Northbound Aerial Structure from Pike Street to Battery Street Tunnel, Northbound Battery Street Tunnel Upgrades, and East Half of SR 519 Interchange

During Stage 4's 30 months of Bypass Tunnel Alternative construction activities, northbound SR 99 traffic will be diverted to the bypass tunnel, the southbound aerial structure (Pike Street to Battery Street Tunnel), and southbound tunnel of the Battery Street Tunnel. Southbound SR 99 traffic will be maintained on the Broad Street Detour. Alaskan Way surface street traffic will be diverted to the temporary roadway above the bypass tunnel.

Traffic Locations (Traffic Stage 4):

- SR 99 northbound – on southbound aerial (Pike Street to BST), southbound BST, and into the completed bypass tunnel
- SR 99 southbound – on Broad Street Detour
- Alaskan Way (south of Pike Street) – temporary roadway above bypass tunnel
- Alaskan Way (north of Pike Street) – streetcar rail bed

Traffic Stage 5 – Surface Restoration and Project Closeout

During Stage 5's 18 months of construction activities, all SR 99 and Alaskan Way surface street traffic will be diverted to their permanent configurations.

6.2.5 Surface Alternative

Summary of Construction Sequencing Plan and Traffic Provision

Construction sequencing, staging, and detour routes for the Surface Alternative are described in the text below and summarized in Exhibit 6-5. The construction will require 98 months to complete.

Traffic Stage 2 – Construction of Seawall, Construct Detours

SR 99 traffic will remain on the Alaskan Way Viaduct with two lanes moving in each direction. On Alaskan Way surface street, one lane of traffic will be maintained for each direction, located under the existing viaduct from S. Massachusetts Street to Pike Street and on the widened Alaskan Way surface street from Pike Street to Broad Street.

Traffic Locations (Traffic Stage 2):

- SR 99 northbound – on viaduct
- SR 99 southbound – on viaduct
- Alaskan Way (south of Pike Street) – under existing viaduct
- Alaskan Way (north of Pike Street) – streetcar rail bed

Traffic Stage 3 – Construct Southbound Aerial (Pike Street to Battery Street Tunnel), Southbound Battery Street Tunnel Upgrade, West Half of SR 519 Interchange

During the 30 months of Stage 3 construction, SR 99 northbound traffic will remain on the viaduct. Southbound SR 99 traffic will use the Broad Street Detour. Alaskan Way surface street traffic will be diverted under the existing Alaskan Way Viaduct with one lane in each direction.

Traffic Locations (Traffic Stage 3):

- SR 99 northbound – on viaduct
- SR 99 southbound – on Broad Street Detour
- Alaskan Way (south of Pike Street) – under existing viaduct
- Alaskan Way (north of Pike Street) – streetcar rail bed

Exhibit 6-5. Surface Alternative Traffic Provisions for All Traffic Stages (Stage 2 Through Completion)

Traffic Stage	Duration (Months)	Provisions for Traffic on SR 99	SR 519 Interchange	Ramps – First Avenue S.	Ramps – Midtown	Ramps – Western/Elliott	Provisions for Traffic on Alaskan Way
2. Construct Seawall, SB Tunnel, & Broad Street Detour	24	Same as existing	None	Open	Open	NB Western off-ramp to be removed for constructing viaduct (Pike Street to Battery Street Tunnel)	1 lane in each direction
3. Construct New SB Aerial (Pike Street to Battery Street Tunnel) & Upgrade SB Battery Street Tunnel	30	NB traffic will remain on existing viaduct; SB traffic diverted to Broad Street & temp. on-ramp	None (west half of interchange under construction)	Open	Open	NB Western off-ramp removed	1 lane in each direction
4. Remove AWV, Construct NB Tunnel, & Perform NB Battery Street Tunnel upgrade; Complete full surface roadway.	30	On surface street with 2 lanes in each direction	SB ramps open, NB ramps under construction	Removed with viaduct	Intersections	NB Western off-ramp removed; SB traffic will operate via temporary Alaskan Way	Mix with SR 99 traffic
5. Restoration	8	On completed roadway surface	Open	Removed	Intersections	None	1 lane in each direction
Total Months	98						
Approx. Total- Years	8						

Traffic Stage 4 – Removal of Viaduct and Completion of Aerial Structure

During Stage 4's 30 months of Surface Alternative construction activities, northbound SR 99 traffic will be diverted to the southbound Battery Street Tunnel, the new southbound aerial structure (Pike Street to Battery Street Tunnel), and temporary at-grade SR 99 (S. Holgate Street to Pike Street). Southbound traffic will use the Broad Street Detour. Alaskan Way surface street traffic will be diverted to the temporary roadway above the seawall with two lanes of traffic in each direction available for detour traffic.

Traffic Locations (Traffic Stage 4):

- SR 99 northbound – on southbound aerial (Pike Street to BST), southbound BST, and northbound temporary at-grade roadway (S. Holgate Street to Pike Street)
- SR 99 southbound – on Broad Street Detour
- Alaskan Way (south of Pike Street) – temporary roadway above seawall
- Alaskan Way (north of Pike Street) – streetcar rail bed

Traffic Stage 5 – Surface Restoration and Project Closeout

During Stage 5's 8 months of construction activities, all SR 99 and Alaskan Way surface street traffic will be moved to their permanent configurations.

6.3 Findings

The objectives of this analysis are to (1) identify probable construction impacts to transportation services and potential problem areas; and (2) identify probable approaches for mitigation where impacts are severe for further analysis before the issuance of the Final EIS.

Generally, in-depth analysis for construction impacts and mitigation measures is most appropriately initiated after the Preferred Alternative is selected and the project is better defined. Detailed technical analysis is required and beyond the scope of this effort at this early stage in the process. Recognizing this, the assessments below are largely qualitative and assessed to the level allowable at the present stage of project definition. The assessment covers all affected transportation modes operating in the corridor. The transportation modes include:

- General highway traffic
- Transit services
- Ferry services
- Parking
- Bicycle and pedestrian facilities
- Freight (trucks and rail)

6.3.1 General Highway Traffic

General Findings

The construction impacts caused by various alternatives on general highway traffic are summarized below.

- All Build Alternatives will cause severe traffic impacts during construction in the corridor. The Rebuild and Surface Alternatives will cause the most severe impacts among all the Build Alternatives, followed by the Aerial, Tunnel, and Bypass Tunnel Alternatives.
- The impacts to traffic on SR 99 are quantified by capacity loss at three major screenlines in the corridor: Midtown, First Avenue S., and Elliott/Western ramps. In this analysis, only the major construction stages are included, i.e., the first stage of site preparation and the last stage of restoration are excluded. This is necessary for two reasons: (1) to avoid diluting the construction impacts in the most disruptive stages; and (2) to screen out the impacts caused by the final configurations, as in the case of the Surface Alternative.
- The Bypass Tunnel and Tunnel Alternatives will cause similar levels of traffic impacts. Mainline traffic will be diverted to the new tunnel after removal of the existing viaduct structure. Through traffic will be reasonably maintained on the new facilities. The Bypass Tunnel Alternative appears to operate slightly better in that (1) the cumulative capacity loss is consistently less than that of the Tunnel Alternative, and (2) it will be easier to complete the construction of the northbound on-ramp at SR 519, which is an important replacement for the existing First Avenue S. on-ramp.
- The Aerial Alternative provides reasonable accommodation for through traffic by the provision of a temporary viaduct structure. The provision of a temporary facility, however, prolongs the construction period. The Aerial Alternative is the alternative with the longest construction period. Thus, the construction impacts will be more severe than those caused by the two tunnel alternatives.
- With the retrofit work carried out on the viaduct while maintaining mainline traffic along construction sites, the Rebuild Alternative cannot provide a reasonable accommodation for through traffic. Considerable traffic diversion to I-5 may occur. Traffic conditions during off-peak hours may be even worse than in peak hours, as further lane reduction and ramp closure may be necessary during construction. The "closure as needed" nature of the construction approach will make it difficult to implement an effective traffic management plan without causing confusion to motorists.
- As in the case of the Rebuild Alternative, the Surface Alternative does not provide a reasonable facility for through traffic during construction. The Surface Alternative is different from the other Build Alternatives in that the traffic conditions will not improve to pre-construction conditions after the completion of construction due to

overall reduction in capacity within the SR 99 corridor. Effective demand management measures are extremely important both during construction and after the completion of the project.

Exhibit 6-6 summarizes the length of construction stages, while Exhibit 6-7 compares the total loss of capacity during major construction stages other than the Site Preparation (Stage 1) and Restoration (last construction stage) stages for all alternatives. The capacity losses are measured at the screenline locations at midtown, First Avenue S., and Western/Elliott Avenues, respectively.

Exhibit 6-6. Duration of Construction Stages

	Rebuild	Aerial	Tunnel	Bypass Tunnel	Surface
Duration of Construction (Months)	86	129	109	102	98
Duration of Major Construction States (Excludes Site Preparation and Restoration Stages)	78	114	96	84	84
Duration of Most Disruptive Construction Stage	78	48	36	30	30

Exhibit 6-7. Capacity Loss During Construction

	Rebuild	Aerial	Tunnel	Bypass Tunnel	Surface
First Avenue S.					
Average Capacity Loss – Duration of Major Construction Stages	53%	29%	25%	22%	48%
Capacity Loss During Most Disruptive Stage	56%	47%	42%	38%	50%
Midtown					
Average Capacity Loss – Duration of Major Construction Stages	49%	29%	28%	25%	48%
Capacity Loss During Most Disruptive Stage	56%	51%	51%	47%	82%
Elliott/Western Avenue					
Average Capacity Loss – Duration of Major Construction Stages	39%	33%	35%	34%	36%
Capacity Loss During Most Disruptive Stage	43%	41%	41%	41%	48%

Rebuild Alternative

Approach of Construction and Traffic Detour

The Rebuild Alternative will require substantially more full closures than the other Build Alternatives (refer to assumptions – Section 6.1 for weekend, 2-week full closures, and summer closures). For periods that do not have full closures, two traffic lanes on the existing facility will be made available during peak hours as rebuilding and retrofitting activities take place along the facility. Mainline lanes and ramps may be closed as required by construction work. Since the lane closure is on an as-needed basis, it will be more difficult to develop and implement an effective traffic management plan.

- With retrofit construction work carried out on the viaduct along with mainline traffic being maintained in two narrowed lanes, the viaduct will undergo considerable traffic congestion throughout the construction period. Motorists will encounter frequent lane shifting, ramp closures, and lane closures when traveling on the mainline.
- Traffic conditions during off-peak hours may be considerably worse than during peak periods, since the number of traffic lanes may be further reduced as required by the construction activities. Complete ramp or viaduct closure may be required.
- During the two major construction stages (Stages 2 and 3), considerable through traffic will tend to divert to I-5 because of the generally poor traffic operating conditions on the viaduct mainline. The two construction stages will require about 78 months to complete.
- One lane in each direction on the surface street can only provide minimum access functions for the properties along the project site.
- There are no construction activities north of the Battery Street Tunnel, and hence no impacts will be caused to the South Lake Union area.

Capacity Loss

The capacity losses for the Rebuild Alternative are summarized below and in Exhibit 6-7.

- The Rebuild Alternative will be completed in 86 months (7.2 years), which is 43 months shorter than the Aerial Alternative. The two disruptive construction stages, Stages 2 and 3, will take 78 months (6.5 years) to complete.
- At the First Avenue S. screenline, the overall average capacity loss is about 53 percent over a period of 78 months. At the most disruptive stage when retrofit work is carried out a the midtown ramp, which will last for about 24 months, ramp closure will be required from time to time. It is estimated that 56 percent of the capacity will be lost.
- At the Midtown screenline, the overall average capacity loss is about 49 percent over a period of 78 months, while capacity loss during the most disruptive stage is estimated at approximately 56 percent.
- At the Elliott/Western Avenue screenline, the overall average capacity loss is about 39 percent, which is comparable to those of the other

alternatives and much milder than at the midtown screenline. During the most disruptive stage, construction activities would cause a capacity loss of 43 percent at this screenline.

Aerial Alternative

Approach of Construction and Traffic Detour – Mainline

Generally, the Aerial, Tunnel, and Bypass Tunnel Alternatives follow the same concept in maintaining through traffic in the SR 99 corridor. A facility of at least two lanes in each direction will have been completed first, before the existing viaduct may be removed. In the case of the Aerial Alternative, the facility is a temporary viaduct, accompanied by temporary ramps and shoofly to provide a facility for through traffic in the corridor.

Pike Street to Battery Street Tunnel

Widening of the Mercer Street Underpass will be performed prior to diverting southbound SR 99 traffic to the Broad Street Detour. Southbound traffic will be diverted to Broad Street, Alaskan Way, and connections to the mainline sections in the midtown area (Broad Street Detour). A two-lane grade-separated structure will be provided near the intersection of Broad Street and Alaskan Way to carry detoured traffic over the BNSF mainline. As the single-level viaduct between Pike Street and Battery Street Tunnel is being replaced, the construction work to upgrade the Battery Street Tunnel will also be performed.

Northbound SR 99 traffic will generally follow the current alignment and Battery Street Tunnel in this segment, and the southbound traffic will be diverted to the Broad Street Detour. The southbound leg of the aerial structure south of the Battery Street Tunnel will be constructed first, together with the upgrading of the southbound Battery Street Tunnel. After completion of the southbound aerial structure, the northbound traffic will make use of the new southbound aerial structure and the upgraded southbound Battery Street Tunnel, which will allow construction of the northbound viaduct (Pike Street to Battery Street Tunnel) and the upgrades to the Battery Street Tunnel. The existing ramps to service the Elliott/Western corridor will be removed.

S. King Street to Pike Street

A temporary viaduct facility with two lanes in each direction will be provided to the west of the current viaduct prior to removal of the existing viaduct and construction of the new aerial structure.

S. Hanford Street to S. King Street

Within this area, a portion of the new aerial structure (S. Holgate Street to S. Royal Brougham Way) lies completely west of the existing viaduct and will be constructed prior to removal of the existing viaduct in that section. The southbound roadway of this section (approximately 2,000 lineal feet) of the new stacked aerial will be connected to the temporary viaduct to complete the temporary viaduct route through the project. A temporary transition structure connecting the lower traffic roadway of the stacked aerial to the surface roadway will be constructed. A minimum of two lanes in each direction will be provided the full length of the temporary SR 99 viaduct route.

Traffic Detour – Ramps

Mandatory traffic detours will be required when ramps are closed or removed prior to constructing the new facilities. Replacement ramps nearby are provided where possible through careful construction planning.

First Avenue S. Ramps

The existing northbound on-ramp and southbound off-ramp will be removed when the existing viaduct is demolished before constructing the new viaduct in Traffic Stage 4. The traffic will be rerouted to the new SR 519 interchange, which will have been completed and open to traffic according to the current construction plan.

Midtown Ramps

The northbound off-ramp at Seneca Street and southbound on-ramp at Columbia Street will be demolished together with the existing viaduct before constructing the new facility. The traffic will be rerouted to the new SR 519 interchange, which will have been completed and open to traffic according to the current construction plan. Southbound and northbound traffic will be diverted to First Avenue S. and other parallel arterials in the downtown area.

Elliott/Western Avenue Ramps

Southbound traffic from the Interbay area will be rerouted to the new Broad Street underpass to Alaskan Way and join the detoured traffic from Broad Street to make use of the connections on Alaskan Way to the mainlines. A detailed traffic detour plan will be prepared after the Preferred Alternative is selected.

The removal of the northbound off-ramp at Western Avenue may cause considerable traffic impacts. At Traffic Stages 2 and 3, the Seneca off-ramp will be a reasonable replacement ramp after the northbound Western off-ramp is removed. The traffic signal timing at the intersection of First Avenue and Seneca Street may be adjusted to provide more capacity for traffic from the off-ramp. This may be performed as a part of the overall area-wide traffic management strategies to be formulated after the Preferred Alternative is selected. At Traffic Stage 4, northbound mainline traffic will be accommodated on the completed new southbound viaduct between Pike Street and Battery Street Tunnel. Since the Seneca off-ramp will be demolished, no ideal replacement will be available for traffic detour. The provision of a temporary left-side off-ramp to Western Avenue will also be studied in the next phase of study on area-wide traffic management strategies for the Preferred Alternative.

Traffic Detour – Surface Street

Throughout the construction period, one traffic lane in each direction will be available on the Alaskan Way surface street to maintain local access of the properties along Alaskan Way. Through traffic will divert to streets in the downtown area. After the Preferred Alternative is selected, an area-wide traffic management plan for adjacent arterials will be formulated. Potential traffic management measures will include:

- Restriction of on-street parking.
- One-way street system.
- Optimized traffic signaling.
- Channelization and other traffic engineering measures.

Capacity Loss

The capacity losses for the Aerial Alternative are summarized below and in Exhibit 6-7.

- The Aerial Alternative requires the longest period to build, as compared with the other Build Alternatives. The overall construction period will be approximately 129 months (10.8 years). It will take 114 months (9.5 years) to complete the three major construction stages.

- At the First Avenue S. screenline, the overall average capacity loss is about 29 percent over a period of 114 months. During the most disruptive stage, which is expected to last for about 48 months, capacity loss is expected to be about 47 percent.

- At the Midtown ramp screenline, the overall average capacity loss will be 29 percent, while capacity loss during the most disruptive stage is estimated at about 51 percent.

- At the Elliott/Western Avenue screenline, the overall average capacity loss will be 33 percent, while capacity loss during the most disruptive stage is estimated at about 41 percent.

Tunnel Alternative

Approach of Construction and Traffic Detour – Mainline

The general provisions for mainline operations in the Tunnel Alternative are similar to those of the Aerial Alternative. One difference is that rather than construct a temporary aerial structure, the new southbound tunnel will be completed first, and will temporarily accommodate both northbound and southbound SR 99 traffic while the existing viaduct is removed before the construction of the new northbound tunnel. Two lanes in each direction will be provided throughout the corridor length.

Traffic Detour – Ramps

First Avenue S. Ramps

The existing northbound on-ramp and southbound off-ramp shall be removed when the existing viaduct is to be demolished before constructing the new tunnel for northbound traffic (Traffic Stage 4). The new SR 519 interchange will provide necessary replacement where feasible. At the beginning of Traffic Stage 4, the southbound ramps will have been completed as a part of the southbound tunnel. The northbound off-ramp at S. Atlantic Street will have been completed. The other northbound ramp at S. Royal Brougham Way, however, may not be able to provide replacement in time, since it needs to be connected to the new northbound tunnel, which will be under construction. A temporary ramp connecting to the southbound tunnel may be evaluated as part of the Preferred Alternative analysis effort.

Midtown Ramps

The northbound off-ramp at Seneca Street and southbound on-ramp at Columbia Street will be demolished together with the existing viaduct before the new facility is constructed. The traffic will be rerouted to the new SR 519 interchange. The northbound off-ramp at S. Atlantic Street will provide necessary replacement for midtown traffic. Southbound and northbound traffic will be diverted to First Avenue S. and other parallel arterials in the downtown area. An area-wide traffic management plan will be formulated in the next phase after the Preferred Alternative is finalized.

Elliott/Western Avenue Ramps

The ramp construction sequencing and traffic provisions are generally the same as those of the Aerial Alternative.

Traffic Detour – Surface Street

As in the case of all other Build Alternatives, one traffic lane in each direction will be available on the Alaskan Way surface street to maintain local access of the properties along Alaskan Way throughout the total construction period. An area-wide traffic management plan will be formulated in the next phase of project development after the selection of the Preferred Alternative. Traffic system management (TSM) and traffic engineering measures will be optimized to the greatest extent possible to help accommodate diverted traffic on the existing roadway facilities.

Capacity Loss

The capacity losses for the Tunnel Alternative are summarized below and in Exhibit 6-7.

- The Tunnel Alternative will require a total of 109 months (9.1 years) to be completed. The three major construction stages will last for a period of 96 months (8 years).
- At the First Avenue S. screenline, the overall average capacity loss is about 25 percent over a period of 96 months. During the most disruptive stage, which is expected to last about 36 months, capacity loss will be about 42 percent.
- At the Midtown ramp screenline, the overall average capacity loss will be 28 percent, while capacity loss during the most disruptive stage is estimated at about 51 percent.
- At the Elliott/Western Avenue screenline, the overall average capacity loss will be 35 percent, while capacity loss during the most disruptive stage is estimated at about 41 percent.

Bypass Tunnel Alternative

Approach of Construction and Traffic Detour

In general, the Aerial, Tunnel, and Bypass Tunnel Alternatives follow the same approach in formulating their respective traffic maintenance plans. A facility of at least two lanes in each direction will have been completed first, before the existing viaduct may be removed. In the case of the Bypass Tunnel Alternative, the facility is the new tunnel, accompanied by temporary ramps to provide a facility for through traffic in the corridor. This approach will provide reasonable accommodation for through traffic throughout the construction period, and the affected area will be considerably confined to the existing corridor and a few parallel arterials.

Traffic Detour – Mainline

The general provisions for mainline operations are similar to those of the Aerial Alternative. The new tunnel will be completed first to accommodate both northbound and southbound traffic while the existing viaduct is removed before the construction of the new tunnel for northbound traffic. Two lanes in each direction will be provided throughout the corridor length.

Traffic Detour – Ramps

First Avenue S. Ramps

The northbound on-ramp and southbound off-ramp will be removed when the existing viaduct is to be demolished, before construction of the new viaduct. Traffic will be rerouted to the new SR 519 interchange, which should have been completed and open to traffic according to the current construction plan.

Midtown Ramps

The northbound off-ramp at Seneca Street and southbound on-ramp at Columbia Street will be demolished together with the existing viaduct before the new facility is constructed. The traffic will be rerouted to the new SR 519 interchange, which should have been completed and open to traffic according to the current construction plan. Southbound and northbound traffic will be diverted to First Avenue S. and other parallel arterials in the downtown area.

Elliott/Western Ramps

The construction sequence and traffic provisions for the Elliott/Western Avenue ramps are generally the same as those for the Aerial and Tunnel Alternatives.

Traffic Detour – Surface Street

As in the case of all other alternatives, one traffic lane in each direction will be available on the Alaskan Way surface street to maintain local access of the properties along Alaskan Way throughout the total construction period. An area-wide traffic management plan will be formulated in the next phase after the selection of the Preferred Alternative.

Capacity Loss

The capacity losses resulting from the Bypass Tunnel Alternative are described below and summarized in Exhibit 6-7.

- Construction of the Bypass Tunnel Alternative will require 102 months (8.5 years) to complete. The three major construction stages will last for 84 months (7 years).

- At the First Avenue S. screenline, the overall average capacity loss is about 22 percent over a period of 84 months. During the most disruptive stage, which is expected to last about 30 months, capacity loss will be about 38 percent.
- At the Midtown ramp screenline, the overall average capacity loss will be 25 percent, while capacity loss during the most disruptive stage is estimated at about 47 percent.
- At the Elliott/Western Avenue screenline, the overall average capacity loss will be 34 percent, while capacity loss during the most disruptive stage is estimated at about 41 percent.
- The Bypass Tunnel Alternative appears to be the least disruptive alternative in that (1) it causes consistently smaller capacity loss at three screenline locations; and (2) the most disruptive stage is shorter by 6 months with less capacity loss.

Surface Alternative

Approach of Construction and Traffic Detour

The general provisions for mainline operations in the Surface Alternative are similar to those for other alternatives, except that after the removal of the viaduct, traffic will be maintained on surface street level with two traffic lanes in each direction.

After completion of construction of the Surface Alternative, the through traffic function of SR 99 will be considerably reduced. Effective transportation demand management measures will be extremely important for reasonable traffic operations in the corridor, both during construction and after completion of the construction work.

Capacity Loss

The capacity loss during construction for the Surface Alternative is difficult to assess since the Surface Alternative does not fully restore corridor capacity in its completed state. The capacity losses calculated here are relative to the corridor capacity of the existing facility, rather than the finished facility, which is consistent with the assessment for the other alternative.

The capacity losses resulting from the Surface Alternative are described below and summarized in Exhibit 6-7.

- Construction of the Surface Alternative will require 98 months (8.2 years) to complete. The three major construction periods will last 84 months (7 years). Unlike the other alternatives, traffic conditions in the corridor will not be improved after completion of the construction work because the capacity of the new facilities will be far below the general traffic demand in the corridor.

- At the First Avenue S. screenline, the overall average capacity loss is about 48 percent over a period of 84 months. During the most disruptive stage, which is expected to last about 30 months, capacity loss will be about 50 percent.
- At the Midtown ramp screenline, the overall average capacity loss will be 48 percent, while capacity loss during the most disruptive stage is estimated at about 82 percent.

At the Elliott/Western Avenue screenline, the overall average capacity loss will be 36 percent, while capacity loss during the most disruptive stage is estimated at about 48 percent. The capacity loss at this screenline will be considerably less than at the other two screenlines, because the single-level viaduct between Pike Street and the Battery Street Tunnel will be replaced, while no new through facility will be provided south of Pike Street.

6.3.2 Transit Services

Construction impacts to transit services in the project construction zone are summarized below.

Buses

Presently four bus routes provide transit services from the north in the SR 99 corridor. They are Routes 5, 5E, 28E, and 358. Since the existing viaduct does not provide a south-to-eastbound ramp to access downtown for traffic from the north, buses take the ramps at Denny Way and make use of city streets to access downtown.

Ten bus lines provide services from West Seattle or further south to Seattle downtown. They include Routes 20, 21E, 26E, 54, 54E, 55, 56E, 113, 130E, 132E, and 135. The buses enter the project area from the West Seattle Bridge or from the south SR 99 corridor. The buses travel on the viaduct for express services. Northbound buses make use of Seneca Street off-ramp for downtown access, while Columbia Street on-ramp is used for southbound buses.

The following summarize the impacts caused by various alternatives.

- The Rebuild Alternative will not cause any impacts to buses to/from the north, since there will be no construction activity north of the Battery Street Tunnel.
- For bus services to/from the southern part of the SR 99 corridor, as well as West Seattle Bridge, no rerouting will be necessary during peak

hours in the case of the Rebuild Alternative. However, prolonged bus travel time is expected throughout the construction period of viaduct retrofit.

- For the Aerial, Tunnel, and Bypass Tunnel Alternatives, there will be minimal disruption to bus services before the removal of the viaduct. After the downtown ramps are removed in Stage 4, buses are to reroute to take advantage of the new ramp of SR 519 and will access downtown via First Avenue S or Fourth Avenue S. Preferential treatments for buses on the diversion routes will be considered and to help reduce delays on the detour routes.
- For the Surface Alternative, buses will be maintained on the viaduct facilities when possible. After the removal of the viaduct, buses may be rerouted to First Avenue S. or Fourth Avenue S. by taking the new SR 519 ramps or to Alaskan Way. Two traffic lanes in each direction will be provided on First Avenue S. under the Surface Alternative. Preferential treatments for buses on the diversion routes will be considered and to help reduce delays on the detour routes.
- Generally, bus travel time in the corridor will be prolonged in the most disruptive stage. The Rebuild Alternative and Surface Alternatives are likely to cause the somewhat more severe disruption to bus services during construction.

Waterfront Streetcar

The Waterfront Streetcar will be removed during construction, whichever alternative is selected. Provisions for bus services on the surface level will be provided to serve the waterfront during construction.

Commuter Rail

Sounder commuter rail services will not be affected by the construction activities in the project corridor.

Monorail Green Line

Based on current schedules, the Seattle Monorail Project Green Line will be completing construction in 2009. Alaskan Way Viaduct and Seawall Replacement Project construction will begin in 2008, so there could be a short period where there are possible conflicts with project traffic detour plans and other construction processes. Detailed planning among many stakeholders will be evaluated during subsequent phases of project development to identify conflicts between these two projects and identify appropriate mitigation strategies.

6.3.3 Washington State Ferries Service

The construction work in the AWV Corridor will cause severe impacts to Washington State Ferries. The adverse traffic conditions on Alaskan Way during construction will degrade the loading and unloading process and affect ferry operations. Where reasonable, vehicular ferry traffic may divert to other sail lines, such as Edmonds-Kingston. Adjustment of services may be necessary. Impacts to Washington State Ferries services at Colman Dock are described below and summarized in Exhibit 6-8.

Holding Area and Vehicular Access

The Colman Dock site currently provides a holding area that accommodates about 650 passenger cars. A gate area with four booths and a total queue capacity of about 35 passenger cars is also provided for departing vehicles.

The existing holding area will be removed during construction. The loss of holding area may seriously affect ferry services at Colman Dock, especially during summer months when there is high demand for ferry services. Provisions for temporary holding will be made at the adjacent Terminal 46 or the WOSCA site on the east side of the existing viaduct. Vehicular access will be made from the temporary holding area to Colman Dock. In the case of the WOSCA site, considerable traffic delay to street traffic will occur as ferry-destined traffic loads into the terminal. More in-depth analysis will be required during development of the Preferred Alternative to better define the impacts and mitigation strategies at this location.

While sufficient holding area for departure is important to ensure no spill-back onto Alaskan Way, sufficient storage area for exiting ferry traffic is also important to facilitate a smooth unloading process. For vehicular access, turning provisions with protected signal phasing will be made for ferry traffic at the entrance, subject to the constraints of the construction requirements. The provision of additional driveways for exiting ferry traffic would help to smooth the unloading process.

Walk-on Passengers

Currently, walk-on passengers enter the Colman Dock Ferry Terminal from Alaskan Way at Madison Street, Marion Street, or Yesler Way, or from the Marion Street pedestrian bridge that crosses over Alaskan Way . During construction, pedestrian crossings over Alaskan Way will be provided so that walk-on passengers may access Colman Dock without difficulties.

6.3.4 Parking

All alternatives will cause severe parking shortage throughout the long construction period. The shortage will be caused by the removal of on-street parking stalls for construction work, as well as the new parking demand generated by construction activities.

Loss of Parking Stalls

During construction, approximately 1,100 on-street parking stalls in the project zone will be removed, including all parking spaces under the existing Alaskan Way Viaduct and ramp on Railroad Avenue. Most of the stalls along the waterfront are for short-term parking, while the majority of the stalls in the stadium area are long-term parking.

In addition to the parking within the construction zone, a few off-street sites have been identified as potential sites for the staging area for contractors. This includes the parking lot for Seattle Aquarium and a parking lot in the Seattle Center area.

Farther away from the project zone, on-street parking spaces may need to be removed to make room for maintaining traffic flow for diverted traffic or for provision of transit priority.

New Parking Demand Resulting From Construction

On the demand side, construction activities will bring in a large number of construction workers, who will need parking facilities for their commuting needs and for carrying out their construction work.

- The number of workers working on the project by phase varies according to alternative and option. Workers needed during major construction range from 1,000 to 1,900 per day. The largest number of workers in any plan can be found in the Tunnel Alternative, with 1,700 to 1,900 workers per day estimated. This figure assumes three shifts per 24-hour day, with the largest shift having 600 to 700 workers.
- Construction workers rarely carpool to the job site for a number of reasons. The percentage of workers using public transit is also low because of the need to bring tools and protective clothing to work.
- An estimated 20 percent of construction worker vehicles will park within the contractor staging area. This includes foremen and shift supervisor vehicles as well as workers during any given day who are bringing especially large or numerous tools and equipment to the project. Assuming the project provides adequate staging areas, the parking required outside of the staging areas would be approximately 450 to 550 worker vehicles.
- A related problem is shift overlap. Assuming three shifts per day and assuming an overlap of 30 to 60 minutes per shift means for about 2

hours per day, the number of construction worker vehicles can reach 1,100 to 1,300.

- Construction workers will park their vehicles in the most convenient locations, and will seek out the limited free parking available. Metered parking is preferred over off-street parking because it provides them schedule flexibility and because it usually costs less. Many shift hours occur during periods when the meter fees aren't in effect. The remainder of the construction workers who cannot locate free or metered parking will use pay lots closest to the job site.

6.3.5 Pedestrians and Bicycles

The construction impacts to pedestrians and bicycles are summarized in Exhibit 6-8 and described below.

Pedestrians

The downtown Seattle waterfront area is a major activity center and tour attraction. It attracts high volumes of pedestrians, especially in tour season. Major pedestrian generators include Seattle Aquarium, Colman Dock, cruise terminals (Terminal 30 and Pier 66), and parks. The construction work along the waterfront will cause substantial impacts to the pedestrian activities, regardless which alternative is adopted. Since there is very limited space available for maintaining all transportation modes in the corridor, the provisions made for pedestrians during construction period will be focused primarily on maintaining connectivity of pedestrian ways access to major pedestrian generators. Emphasis will be placed on maintenance of pedestrian facilities consistent with standards established by the Americans with Disabilities Act.

The provisions to be made for pedestrians are as follows:

- Sidewalk will be provided on one side of Alaskan Way.
- Contractors will maintain pedestrian access to premises along the project site.
- Pedestrian crossings will be provided at regular intervals, where safely practical, along Alaskan Way.

Bicycles

The paved pathway along the waterfront will be removed, and the roadway section of Alaskan Way reduced during construction. Bicyclists will be directed other downtown streets to maintain connectivity within the regional bicycle network.

6.3.6 Freight Mobility

Trucks

The construction impacts to trucks are described below and summarized in Exhibit 6-8.

Presently, the viaduct carries some 3,000 trucks per day. The maximum hourly truck volume amounts to about 300. About 50 percent of the trucks are small to medium trucks, primarily making local deliveries. The viaduct currently serves about 550 large trucks per day, and they mostly use off- and on-ramps at Western/Elliott Avenues on the north end. Tanker trucks also tend to use the ramps at Western and Elliott Avenues.

Oversized or overweight trucks are limited to the designated over-legal route along Alaskan Way and Broad Street. Trucks larger than 27 feet are precluded from using city streets in the downtown area north of S. King Street in daytime.

The construction impacts to delivery trucks will be similar to those of the general traffic. Trucks and general traffic will endure similar levels of traffic delay and congestion. They will follow the general traffic for diversion as required. As in the case of general traffic, trucks may stay on the temporary or new mainline facilities at Stage 4 with the Aerial, Tunnel, and Bypass Tunnel Alternatives. The traffic impacts will be considerably less than those caused by the Rebuild and Surface Alternatives.

For large trucks, the most critical facilities will be the on- and off-ramps at Western Avenue and Elliott Avenue. Temporary ramps to access Western and Elliott Avenues will be important to large trucks. The feasibility of provisions for temporary ramps will be conducted after the Preferred Alternative is selected and the project is better defined. In case no temporary ramp can be provided for trucks, trucks will reroute to the nearest available ramp. The ramps may include the off-ramps at SR 519, Seneca Street, or Denny Way. For large and over-sized trucks, use of the Battery Street Tunnel may not be allowed. Use of city streets for bypassing the construction site may be necessary.

On surface street level, E. Marginal Way is the major access route for the Port of Seattle, as well as the container yards in the stadium area. Provisions are to be made by the contractors to maintain truck access in and out of the container yards. Additional driveways will be needed.

Freight Rail

The BNSF maintains two mainline tracks through the study area, paralleling I-5 to the south and running between First and Fourth Avenues S. crossing

S. Spokane, S. Lander, and S. Holgate Streets and S. Royal Brougham Way (SR 519) at-grade. North of S. Royal Brougham Way is the King Street Station and a tunnel under the downtown area that emerges north of the Pike Place Market and follows the waterfront to points north. This route serves the Interbay switching and engine maintenance and refueling yard.

- Whatcom Rail Yard, which is located to the west of the existing SR 99, will be removed during construction. In the case of the Aerial Alternative, the yard will be restored at the current location, with possible loss of one or two tracks. With the other alternatives, the yard will be relocated to the east side of the new SR 99 after construction.
- In the case of the Aerial Alternative, minor relocation of tracks immediately adjacent to the new SR 99 alignment at the north end of the BNSF SIG Rail Yard will be required for tail track connection. As to the other alternatives, the BNSF SIG Rail Yard will be expanded on its southern end to compensate for the loss of tracks both during and after construction.
- There is a tail track on Terminal 46 to the west of the alignment of the existing SR 99. In the case of the Aerial Alternative, the tail track will not be affected. As to the other alternatives, minor relocation will be required.

6.3.7 Summary of Findings

Exhibit 6-8 summarizes the construction impacts to transportation services in the project corridor. A pie chart system is used to compare the severity of construction impacts caused by each alternative. Measurements are based on general qualitative assessment of impacts of construction for all Build Alternatives. The ranking reflects degrees of severity of impacts for each alternative as it is compared to the other alternatives.

6.4 Construction Mitigation

6.4.1 Flexible Transportation Strategies

Overview

The Flexible Transportation Package is an organizing set of programs that brings together synergistic transportation strategies that benefit from being considered and implemented in a coordinated fashion. The proposed package comprises strategies that are usually categorized as transportation system management (TSM), transportation demand management (TDM), intelligent transportation systems (ITS), transit services, and pedestrian and bicycle improvements. The strategies included in this package are included in each of the Build Alternatives under study.

This Flexible Transportation Package is proposed to provide the system and demand management tools needed to respond to changing conditions, with the focus of investments targeted for the construction period.

Exhibit 6-8. Summary of Construction Impacts

	Design Plans				
Transportation Mode	**Rebuild**	**Aerial**	**Tunnel**	**BypassTunnel**	**Surface**
General Highway Traffic	●	◕	◑	◑	●
Transit Services	◑	◑	◑	◑	◑
Ferry	◕	◕	◕	◕	◕
Parking	●	●	●	●	●
Bike/Pedestrians	◕	◕	◕	◕	◕
Trucks	●	◕	◑	◑	●
Rail	◑	◔	◑	◑	◑

<u>Severity of Impacts</u>

● Extremely severe
◕ Very Severe
◑ Severe
◔ Moderate
○ Light

Strategies

The following section provides a summary of the flexible transportation strategies selected to be implemented for all five Build Alternatives. The emphasis of these strategies will be to help mitigate traffic congestion during construction. Exhibit 6-9 provides potential performance benefits of the strategies if implemented in the corridor. Further work during the development of the Preferred Alternative will be required to better define the role and function of these strategies. This analysis will also yield more precise information on performance benefits and impact mitigation effectiveness as appropriate.

Exhibit 6-9. Summary of Flexible Transportation Strategies Performance Benefits

Strategy	Performance Benefit
Construction Mitigation	
Construction Worker/Commuter Shuttle Service	Shifts up to 3,500 trips per day from other modes (assumes 40% transit use during day, 2,400 workers during peak construction period). Workers would be provided with free FlexPasses to encourage transit access to job site. Addresses commute trips along waterfront displaced by temporary elimination of streetcar service during construction.
Expansion of FlexPass Program During Construction	750 new FlexPasses per year. Shifts 900 trips per day to HOV and transit (assumes 60% use).
Personalized Transportation Consultation	Consultation service provided yearly during construction to over 2,200 households that have travelers who use the AWV Corridor on a regular basis. Greater emphasis on non-work trips. Similar efforts have helped reduce vehicle trips and VMT fell by 15%. Transit use increased.
Traveler Information Systems	Allows a driver to avoid traffic problems, save time, and reduce frustration.
Conversion of Long-Term Downtown Commuter Parking to Short-Term and Carpool Parking	Converts up to 200 off-street long-term parking (commuter) spaces along the corridor to short-term or carpool parking, thereby increasing long-term commuter parking costs in corridor, which induces shift to HOV modes.
Implementation of Truck/Commercial Vehicle Restrictions and Prioritizations	Maximizes limited road capacity available to commuters during peak commute periods when road closures are needed during construction.
Event Management System	Reduces impact of major traffic surges from events during construction.
Smart Work Zones	Travel time and safety benefits provided by improved information and incident response systems during construction. 50:1 ratio of benefit to costs estimated for similar program in Nebraska, based on accident reduction and travel time savings.
Enhanced Traffic Signal Systems and Programs	Reductions in delay due to adaptive control range between 14 and 44 percent. Other benefits may include reduction in fuel consumption, reduction in traffic signal violations, increase in travel speed, reductions in vehicle emissions, and reduced crash risk.
Incident Management Systems	Reduces impacts in the following areas: • Incident clearance time: 38–66% • Emergency vehicle response time: 20–30% • Primary crashes: 35–40% • Secondary crashes: 30–50%

Exhibit 6-9. Summary of Flexible Transportation Strategies Performance Benefits (continued)

Strategy	Performance Benefit
Direct Transit Enhancements, Including Possible Water Taxi Service	Tens of millions in dollars for direct subsidy primarily for expanding service hours. Helps achieve transit demand needs in corridor.
Expand Vanpool/VanShare Program	Provides almost 130 new vans for service, 70% of which would be deployed during construction period. Shifts over 1,600 SOV trips per day (assumes 80% use).
Small Employer Market Development	Supports other strategies (specifically FlexPass and vanpools programs). Extends Commute Trip Reduction services to smaller employers, which represent two-thirds of downtown Seattle employment base.
Parking Lot Guidance Systems	Reduces commute time and surface congestion due to circling vehicles.
Flexible Transportation Program Management and Monitoring/ Demonstration and Research Programs	Optimizes Flexible Transportation Program to adapt to changing conditions. Contributes to regional efforts to innovate and adapt program to changing markets.
Options for Further Consideration During Development of the Preferred Alternative	
Transit Priority Measures	Reduces travel time through congested streets by 10% in some applications. Transit ridership increase depends on location-specific travel time savings. Helps provide for increased transit coverage of downtown.
Ramp Metering	Reduces impacts in the following areas: • Reduce accidents: 15–50% • Increase speeds: 16–62% • Increase throughput capacity: 8–22%

Construction Worker/Commuter Shuttle Service

This measure would provide worker and commuter shuttle service from outlying temporary or permanent parking facilities into the work zone area. The project would help to reduce directly the number of vehicles that enter a highly constrained work area. Cost includes transit service and long-term leased parking. Parking areas in the vicinity of Seattle Center, the Interbay area, the stadiums, and points further south would be considered as potential temporary parking locations.

Expansion of FlexPass Program During Construction

FlexPass is a comprehensive commute benefits package for all or most employees in a worksite, activity center, or residential area. Generally, FlexPasses are distributed to all eligible users for a reduced rate, and the employer or sponsor is billed based on the actual amount of use charged to the FlexPass. Since ridership and therefore farebox revenue increases, the transit agency usually subsidizes the incremental cost to the sponsor in the first years of implementation. This strategy, along with increased transit service, will provide increased incentives for commuters to choose transit during construction. To support a strong increase in transit use during construction, this program provides a higher than typical subsidy that is stepped down over a period of years.

Personalized Transportation Consultation

Personalized transportation consultation brings marketing and trip planning services to the neighborhood. Outreach is targeted to households in primary markets served by the AWV Corridor. Marketing staff canvasses a neighborhood in the market area providing one-on-one meetings to educate residents on the transportation options and to tailor solutions specific to the needs of the households. This program is well suited to services such as the formation of vanpools within a neighborhood. Personalized transportation consultation has particular application during construction, when residents' typical travel patterns may be disrupted.

Personalized transportation consultation fills a gap in typical marketing and support services by focusing on the home end rather than just the work end of the trip. It also can be highly effective in extending the reach of existing efforts because it addresses both work and non-work trips.

Traveler Information Systems

Extensive traveler information and support during construction periods will be featured as part of this program. This program will focus on the technological needs of getting the word out on construction activities and general transportation system operating conditions. This includes systems such as dynamic message signs, highway advisory radio, e-mail alerts, and project web sites that provide real-time information on traffic conditions around construction areas. Hardware and software systems developed for this strategy can be used beyond the construction period, though operations and maintenance funding will need to be secured from non-AWV project sources.

Conversion of Long-Term Downtown Commuter Parking to Short-Term and Carpool Parking

Replacement of the Alaskan Way Viaduct will require the closure of a significant number of metered (short-term) parking stalls along the Seattle waterfront, where short-term parking is always in demand to serve business users and waterfront visitors. The program assumes these parking stalls will be replaced in some future configuration that conforms to the final waterfront surface street improvement plan.

This strategy will lease up to 200 long-term parking stalls in the immediate vicinity of the project and convert these stalls to short-term only. By instituting a program whereby long-term parking is converted to short-term (like the current metered parking), customers for waterfront businesses will still have available parking and the reduction of long-term parking will serve as an inducement for commuters to switch to alternative modes to get to and from work. While this project will not make up the entire shortfall of parking during construction, it can help to reduce corridor long-term parking demand. Further analysis during the development of the Preferred Alternative will be needed to better estimate the effectiveness of this strategy.

Implementation of Truck/Commercial Vehicle Restrictions and Prioritizations

This strategy would implement time prohibitions for truck and/or commercial vehicle operations around construction work zones or congested corridors affected by construction activity. This would also include trucks and commercial vehicles supplying construction materials to specific work sites if traffic demands warrant this treatment.

Event Management System

Event management systems address congestion and delays that result from activities at Seattle Center, sports stadiums in the Pioneer Square/SODO neighborhoods, and events at the Seahawks Stadium Exhibition Center. The project supports these strategies by providing for an event management server to coordinate traffic signal control and route guidance and by supporting special event shuttle service. Signs and other system capital equipment developed for this strategy can be used beyond the construction period, though operations and maintenance funding will need to be secured from non-AWV project sources.

Smart Work Zones

These systems apply the use of video, signaling, and traffic technologies that provide a portable traffic management system to help make travel through the roadway construction zones safer and more efficient. This system would also include the application of variable speed limit signs to better manage traffic flow in the immediate vicinity of a construction zone or upstream/ downstream from zones.

Enhanced Traffic Signal Systems and Programs

Traffic signal system enhancements such as updated traffic signal plans (Quick Response), adaptive signal control, signal optimization systems, and traffic operations center upgrades, will help improve traffic flow on nearby streets during construction. These programs address the broader downtown street traffic signal systems network indirectly affected by construction impacts, in comparison to the Smart Work Zone systems that help manage traffic in the immediate vicinity of major project work sites.

Incident Management Systems

Incident management systems are planned and coordinated strategies to detect, respond to, and remove traffic incidents and restore traffic capacity as safely and quickly as possible. Typically, incident management systems include programs to detect incidents and to clear them from the roadway quickly. The process involves a number of public and private sector partners, including law enforcement, fire and rescue, emergency medical services, transportation, public safety communications, emergency management, towing and recover services, hazardous materials contractors, and traffic information media. This program would enhance existing systems and strategies by including project construction activities to address incident response needs.

This program should also address non–traffic-related incidents around construction zones to facilitate safe and efficient responses. In addition to the stakeholders mentioned above, other stakeholders affected by non-traffic incidents, such as utility infrastructure accidents, should be included in planning and coordinating activities.

Direct Transit Enhancements, Including Possible Water Taxi Service

Based on City and regional policies, transit person trip demand is expected to grow significantly in the greater downtown Seattle area. Many demand and system management strategies recommended for the Alaskan Way Viaduct and Seawall Replacement Project require adequate transit service to meet the expected growth in transit demand. However, recent trends in revenue for transit service, if carried out to the future, may not be adequate to meet this demand.

To address this need, the project will contribute a significant allocation of enhancement funding to help address primarily transit service (service hours) needs during the construction period. Specific options on how the funding would be used are not known at this time and could be identified during the development of the Preferred Alternative.

Expand Vanpool/VanShare Program

Vanpools are effective for serving secondary destinations such as South Lake Union, the Ballard industrial area, Harbor Island, and other non-CBD destinations, which are not easily accessible by transit to the entire region. A VanShare program provides vans to commuters to link their work site or home to a transportation terminal such as a train station, park-and-ride lot, or ferry terminal. The project envisions a significant increase in vanpools in the AWV Corridor over the 2030 planning horizon for a total increase of 128 vanpools (70 percent of which would be put in place over the construction period). The project provides the capital cost for initial purchase of vans and replacement over the planning period. Operating costs are borne by the users. The viaduct project's share of the total capital cost is assumed to be 25 percent (the viaduct's approximate share of traffic entering the downtown). Operating funds could also be provided to establish a VanShare program during construction.

Small Employer Market Development

The Small Employer Market Development strategy extends the travel choices, marketing, and support services that Commute Trip Reduction-affected employers enjoy to employers with less than 100 employees. These smaller employers represent approximately two-thirds of the employees in the downtown based on recent estimates. This program provides for aggressive marketing during construction.

Parking Lot Guidance Systems

This system automatically monitors parking lot availability and uses dynamic message signs to disseminate information to drivers so that they can go directly to parking lots with available parking. By providing information about parking lot availability, travelers will not have to needlessly search for parking, thus reducing the demand on congested roadways.

Flexible Transportation Program Management and Monitoring/Demonstration and Research Programs

This effort is required to help manage the array of flexible transportation programs implemented during the project construction period. It is imperative that programs be monitored to provide important feedback. This feedback will help program managers and decision makers determine which programs are not meeting performance targets and make modifications or terminate ineffective programs, if necessary. Feedback can also identify effective programs that may be considered for expansion. A portion of project resources could be set aside for demonstration projects on new and innovative strategies that can help to meet and exceed project performance objectives. This effort could be valuable in determining the most cost-effective approaches to meeting the changing mobility needs of persons and goods in the corridor and the travel markets it serves.

Other Options for Further Consideration During Development of the Preferred Alternative

Other strategies that show promise for effective construction mitigation are noted below. These strategies will require more detailed analysis and agency consultation during the development of the Preferred Alternative to determine their best configuration during the construction period.

Transit Priority Measures

If traffic accessing or exiting the AWV Corridor during construction causes congestion on adjacent streets, transit vehicles using those ramps will be affected. If delays to transit can be mitigated through transit priority measures without adversely affecting other traffic, delays to transit riders will be reduced and the attractiveness of transit will be enhanced. Specific transit priority measures (e.g., transit signal priority systems, queue bypass and transit-only lanes) will need to be defined on a site-specific basis, considering the extent of transit use, impacts assessment of arterial traffic conditions due to the project, and the feasibility of implementing an effective solution.

Ramp Metering

Metering helps to moderate the rate of traffic growth leading into the peak travel periods or during heavy construction where roadway capacity is more limited, thereby allowing a high volume of traffic flow to be maintained during a greater portion of the peak period. It also increases the spacing between merging vehicles into the traffic stream, which allows for safe merging and reduced accident rates at merge points. This measure would install ramp meters and related surveillance, detection, and communication devices. Ramp meters would not be turned on unless traffic volumes approach congested conditions and they meet WSDOT and City of Seattle operations requirements.

6.4.2 Parking Mitigation

Parking mitigation strategies during construction will be similar to those described in Section 5.8.4 for post-construction conditions. Loss of short-term parking for the Pioneer Square and central waterfront (two distinct areas) will be mitigated. In addition, a number of measures described under the Flexible Transportation Package (Section 6.4.1) are aimed at reducing automobile trips in the study area during the construction period, and thereby will reduce parking demand.

Possible mitigation measures, as described in the aforementioned sections, could include:

- Build a parking structure.
- Lease existing parking lots or structures.
- Acquire existing parking lots or structures.
- Contract for replacement parking.
- Convert existing long-term parking to short-term parking.
- Provide off-site parking with shuttle service.

This Page Intentionally Left Blank

Chapter 7 REFERENCES

Central Puget Sound Regional Transit Authority Sound Transit Sound Move Vision Plan.

City of Seattle and WSDOT accident data.

City of Seattle City Center Circulation Plan (Ongoing - 2003).

City of Seattle Comprehensive Plan (Toward a Sustainable Seattle).

City of Seattle Intermediate Capacity Transit Study. 2001.

City of Seattle Mercer Corridor/South Lake Union Transportation Study, Phase II. 2003.

City of Seattle traffic volume data.

King County Metro 6-year Transit Development Plan.

King County Metro Transit Schedules.

KJS Assoc., Inc. 1999. Washington State Ferries Systems Plan for 1999-2018, Final. June 1999.

Parsons Brinckerhoff. 2002. SR 99: Alaskan Way Viaduct Project: No Action Alternative (Existing Conditions) Report. Seattle, Washington.

Parsons Brinckerhoff Draft Flexible Transportation Package. 2002. An Integrated Program of Demand and System Management Strategies. Seattle, Washington.

Parsons Brinckerhoff Alaskan Way Viaduct and Seawall Replacement Project. 2004. Draft Existing Conditions Data Documentation Report.

Parsons Brinckerhoff Alaskan Way Viaduct and Seawall Replacement Project. 2004. Draft 2030 Existing Facility Scenario Data Documentation Report.

Parsons Brinckerhoff Alaskan Way Viaduct and Seawall Replacement Project. 2004. Draft Rebuild Plan Data Documentation Report.

Parsons Brinckerhoff Alaskan Way Viaduct and Seawall Replacement Project. 2004. Draft Aerial Plan Data Documentation Report.

Parsons Brinckerhoff Alaskan Way Viaduct and Seawall Replacement Project. 2004. Draft Tunnel Plan Conditions Data Documentation Report.

Parsons Brinckerhoff Alaskan Way Viaduct and Seawall Replacement Project. 2004. Draft Bypass Tunnel Plan Conditions Data Documentation Report.

Parsons Brinckerhoff Alaskan Way Viaduct and Seawall Replacement Project. 2004. Draft Surface Plan Conditions Data Documentation Report.

PSRC Destination 2030 Metropolitan Transportation Plan.

PSRC regional travel demand forecasting model.

Puget Sound Regional Council (PSRC) parking data.

Seattle Popular Monorail Authority Plan. 2002.

Sound Transit schedules.

Sound Transit/King County Evaluation of Joint Operations in the Downtown Seattle Transit Tunnel. 2001.

Transportation Research Board Highway Capacity Manual. 2000.

Waterfront Parking Strategy Study. 2002.

WSDOT (Washington State Department of Transportation). 1996. Alaskan Way Viaduct Project: Task 1 Report.

WSDOT (Washington State Department of Transportation). 1999. Washington State Ferries. 1999. Systems Plan for 1999-2018.

WSDOT (Washington State Department of Transportation). 2002. Draft Flexible Transportation Package, An Integrated Program of Demand & System Management Strategies (report). December 2002. Seattle, Washington.

WSDOT (Washington State Department of Transportation). 2002. City of Seattle, and Federal Highway Administration SR 99 Truck Study (Draft).

WSDOT (Washington State Department of Transportation). 2003. Statewide System Plan.